WIRE AND WIRE PRODUCTS

FEBRUARY 1943

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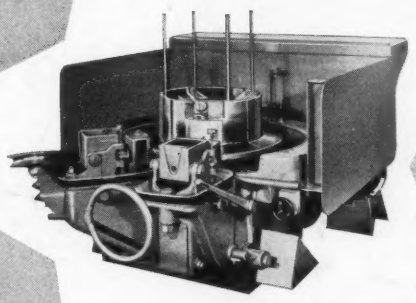
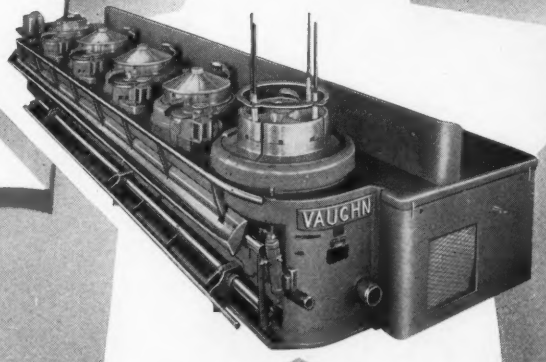
and TOMORROW'S *TOO!*



Vaughn

MOTOBLOC *and* MOTOBLOX



The Vaughn Motobloc, in single or double-deck types, and Vaughn Motoblox non-slip, controlled speed continuous machines, are producing all sizes and grades of wire for war purposes—in a broad range of speeds, effectively and dependably, with the year-in and year-out *steady performance* that sees the job through!

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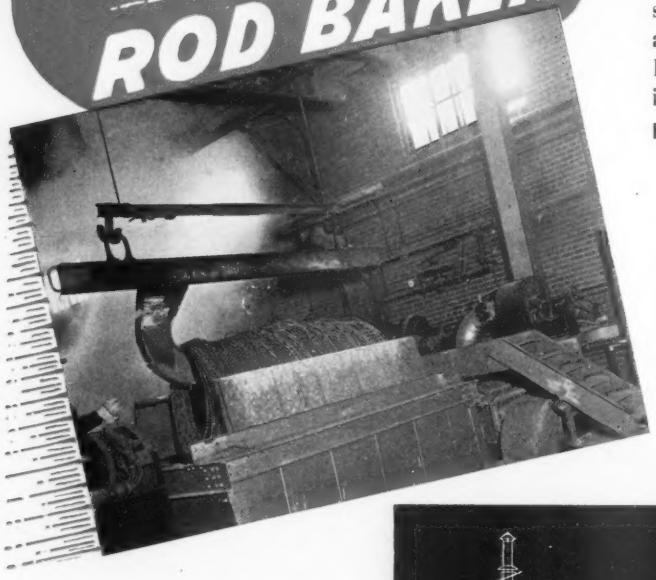

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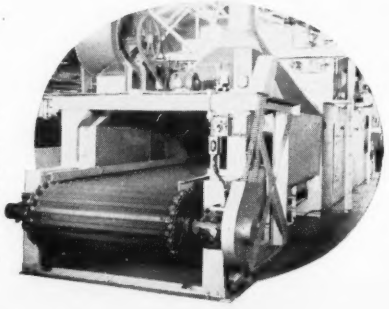
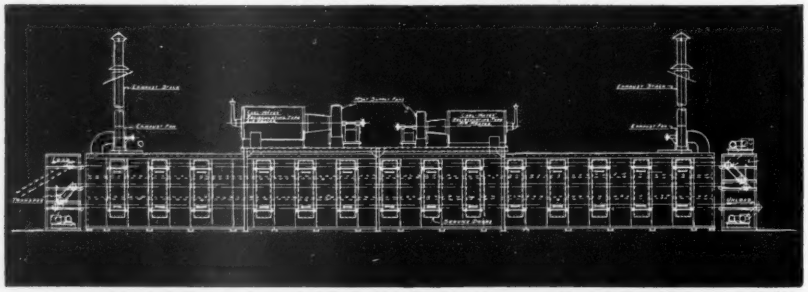


WELDING ROD OVEN



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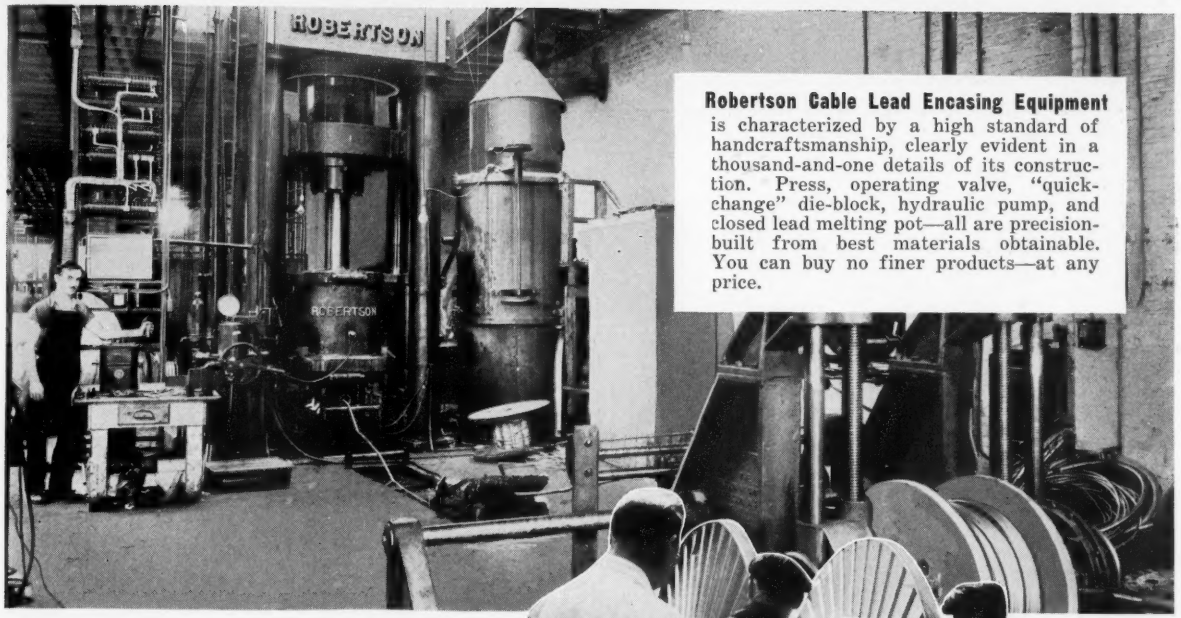

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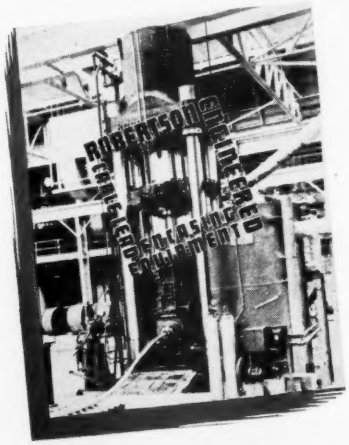

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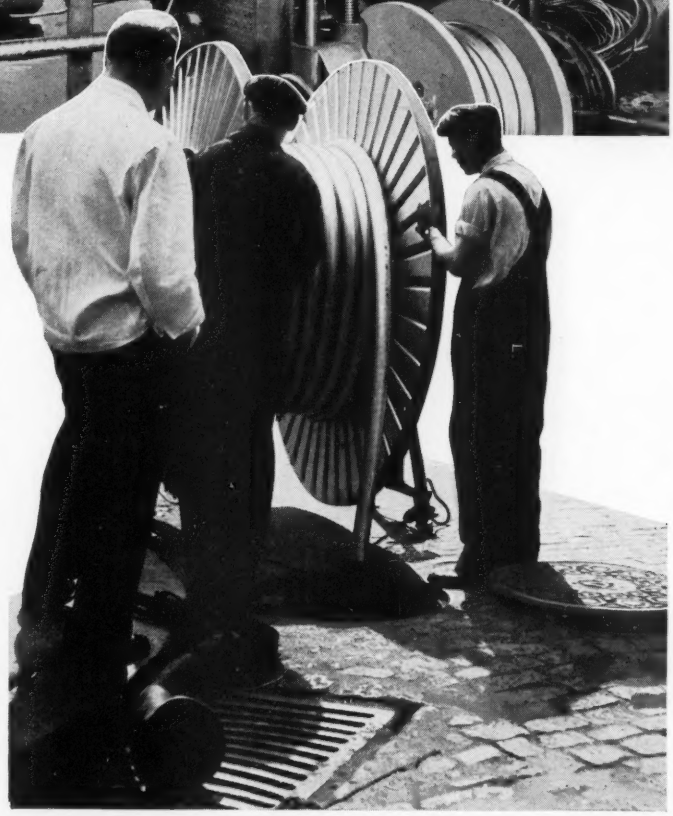

MOST OF THE LEAD ENCASING CABLE produced in the United States and Canada is lead-sheathed by ROBERTSON cable lead encasing equipment . . . for, ROBERTSON machines are recognized industry-wide as the standard for efficient, dependable service at minimum cost per production hour.

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SAFE WAYS IN WAR PRODUCTION

NEW WORKER—Every new employee in a Bethlehem Plant wears this button. It helps to fix his attention on safety. It signals to more experienced employees that he is new to the plant, and they keep an eye on him, and do not hesitate to offer friendly guidance in case he forgets instructions and unknowingly breaks any safety regulation.

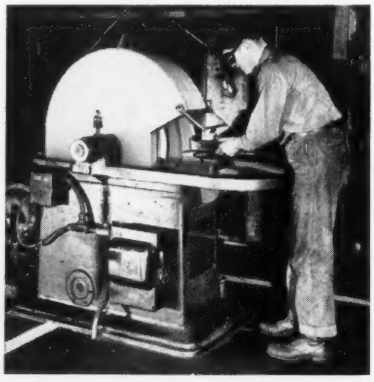
Industrial accidents, bad enough because of the human distress they cause, are also a grievous drag on production. Every day that injury lays up a worker means lowered output of the materials our armed forces are asking for.

Safety engineers know they must be more than ever on guard as pressure for production intensifies and men work against time. When war came, Bethlehem Steel Company expanded its accident-prevention program to meet the new conditions. Special efforts were addressed to the new employee to make him safety-conscious from the moment he walked into the plant. And by posters, group meetings and individual instruction, the safe way of doing his job was ground into the subconscious of new Bethlehem employee and veteran alike.

Significant are the results of a current study, showing that of all disabling accidents to Bethlehem employees less than one-third occur in the course of their work. Even with employment rolls upped by the tens of thousands and plant operations at top speed to meet the demands of the war program, the Bethlehem employee is safest, best protected against injury, during the hours he spends on the job.

AUTOMATIC HAND GUARD—This man is operating a trimming press. If he should absent-mindedly let his hands move too near the danger zone, the two cables will automatically whisk them back to safety, before the ram of the press descends.

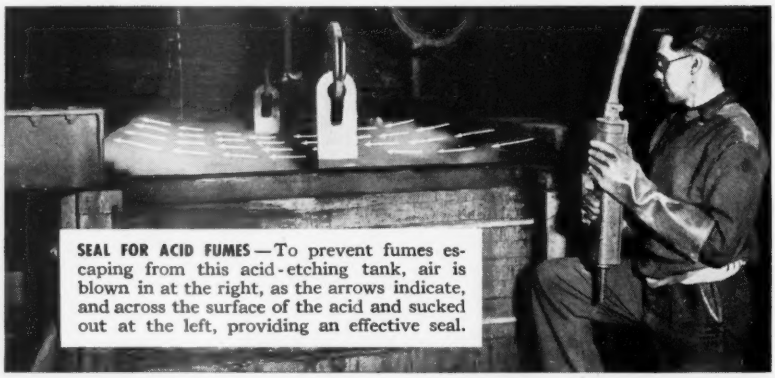
100% HEAT-INSULATED—Asbestos-covered hood, chrome-leather full-length apron, chrome-leather gloves, chrome-leather full-length sleeves and asbestos guard on torch handle give this worker complete protection against heat and flying sparks.



EYES DOUBLY GUARDED—Even though this grinder is equipped with a heavy glass shield, the eyes of the man who is operating it are given further protection against sparks or flying bits of abrasive by the cup goggles that he is wearing.

BETHLEHEM STEEL

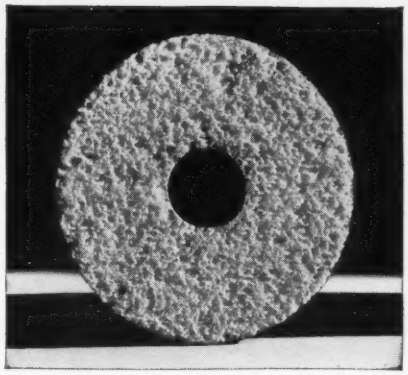
Bethlehem Steel Company is actively supporting the National Safety Council in its campaign against accidents in war production, through the War Production Fund to Conserve Manpower.



SEAL FOR ACID FUMES—To prevent fumes escaping from this acid-etching tank, air is blown in at the right, as the arrows indicate, and across the surface of the acid and sucked out at the left, providing an effective seal.

Which Wheel Structure for YOUR Job . . . *Dense, Medium, Open ?*

MOST ordinary tool and cutter jobs and surfacing jobs require either the fairly dense No. 5 structure or the medium No. 8 structure, the choice being dependent on the size and shape of the tool or part and the area of contact. There are jobs however where the Norton very open, No. 12, structure (illustrated) will be found best, such as:



No. 12 Structure (Open)

(1) Surface grinding with periphery of wheel of hard, heat-sensitive steels,

(2) Hob grinding, especially when heavy cuts must be taken,

(3) Form tools or other grinding where accurate contours are required, except where acute included angles are involved. (Structure No. 12 wheels, because of their large pores, should not be trued to a sharp, thin point.)

Norton engineers will be glad to study your tool room and surfacing jobs and select the wheel structure which will be best for each one

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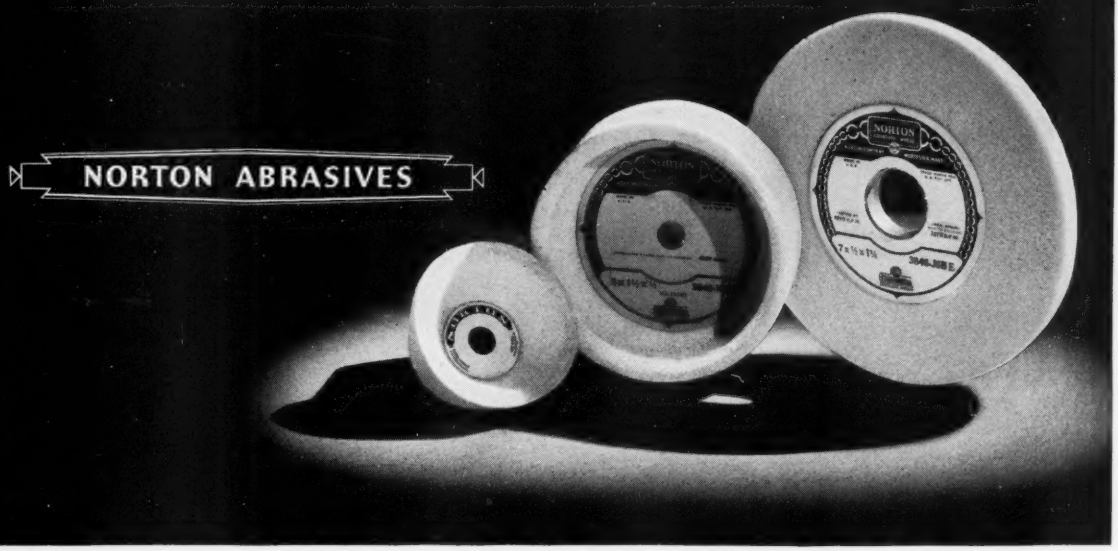

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FROM AN ORIGINAL DRAWING BY ORISON MACPHERSON

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437

Ramet

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FOUNDRY & MACHINE COMPANY
Waterbury, Connecticut, U. S. A.
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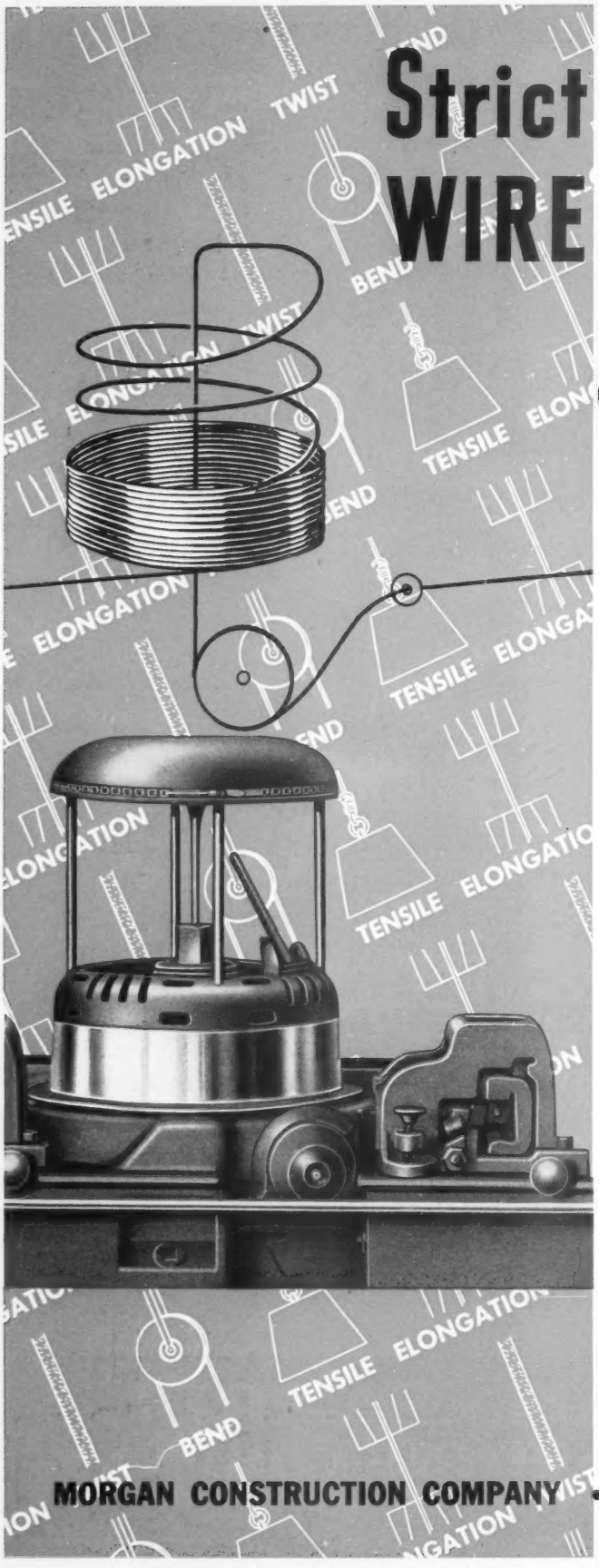

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It twists — it bends — it lifts and pulls — taking the unusual wear and tear of today's hurry-up action.

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This ability is evident in the basic design and improved construction of Morgan Wire Drawing Machines. The famous Morgan "high block" with its improved air-cooling feature gives all the advantages of single-hole wire drawing with complete freedom in the arrangement of drafts. The multiple block construction affords the production advantages of continuous drawing of high carbon stock at high speed. The solid strength of Morgan machinery affords a safe margin of dependability in today's peak-load operations. Modern safety features and simplified handling widens the field for operators.

W-83

AC Motor Drive?
Certainly!

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 18 FEBRUARY, 1943 No. 2

Designated as

Official Publication By The Wire Association

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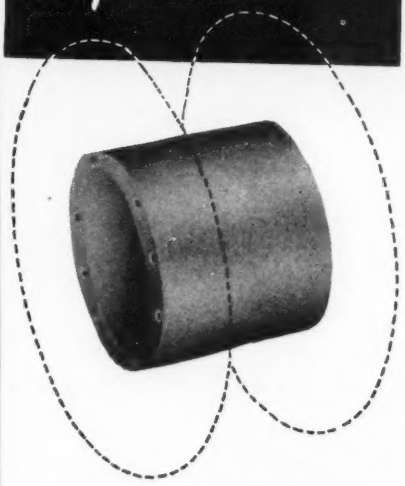
7 Cost Reducing Features in Stevens Flanged Steel Traverse



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(2) Makes a stronger reel.

(3) Increases number of trips per reel from 50% to 100% before cut downs or complete scrapping of wooden reel heads.

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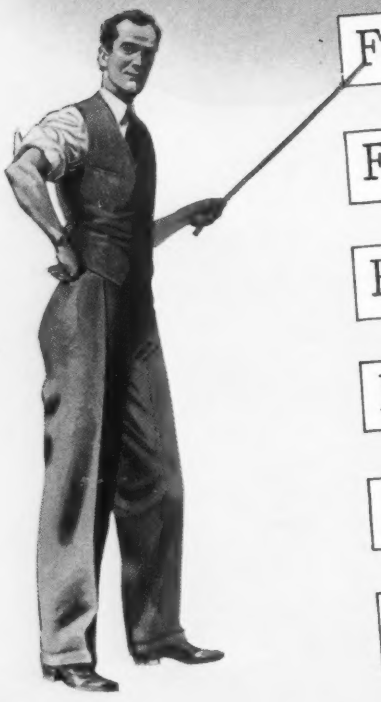

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Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING --- EXTRUDING --- FORMING --- FABRICATING

Vol. 18 FEBRUARY, 1943 No. 2

New Criteria for the Selection of Diamonds for Wire Drawing Dies

By Paul L. Herz
Consultant, New York, N. Y.

Foreword

Selecting diamonds for dies is one of the most important features in the die making industry because, other factors being equal, the quality of the diamond determines the life of the die, and even the most expert workmanship cannot alter this fact. Efficient selection requires an intimate knowledge of diamond structure and of crystal habit as well as wide experience in the comportment of diamonds in industry. Unfortunately diamond selection has been influenced largely by traditional beliefs which, when traced back, as we will see, rest upon nothing but fairy tales. Most of them rely upon undefined notions of hardness attributed to diamonds of particular origins. I do not hesitate to state that this standard of appraisal is utterly fallacious and misleading, and should be discarded. I will endeavor, in this article, to separate the wheat from the chaff and establish a general basis for selection in the light of up-to-date experience and knowledge. Considering the deeprooted credence attached to the tradition I feel impelled to delve into the matter at some length. In my description of various types of diamonds, I resort to the use of many names and adjectives with the purpose of making identification of such diamonds easier for the reader.

HERETOFORE, selection was based upon purity and a vague conception of hardness. The question of purity is fairly well understood but requires some clarification. That of hardness is utterly fallacious because the conception of hardness itself remained undefined and was then attributed in varying degrees to diamonds according to their origin.

✦ ✦ ✦

IT was said that Australian diamonds were the hardest, next came stones from the Bahia district of Brazil, followed by those of the Jagersfontein mine and the Premier (Transvaal) mine.

✦ ✦ ✦

THEN followed the other mine stones in this order: Bultfontein, Wesselton - Kimberley - Debeers, etc., and the end of the list was cluttered with the great mass of South American and African alluvials, and lastly, the Belgian Congo output.

Hardness

WHAT exactly do we mean when we say that a diamond is "hard"? Hardness as defined by the dictionary has many meanings. Hardness as used in scientific vernacular to define physical properties also has many meanings. It may mean resistance to compression, to torsion, to rupture, to tension, to crushing, to bending, etc., etc. But for our purpose, which is wire drawing, when is a diamond "hard"?

✦ ✦ ✦

THE answer is, when it withstands successfully the trials of wire drawing. Let us examine these trials in detail. A wire is drawn at great speed through a funneled hole drilled into the diamond. The two factors of deterioration are:

1. **Wear caused by violent friction and considerable pressure on the polished canal.**
2. **The centrifugal stress created by the the elongation of the wire in the funnel.**

✦ ✦ ✦

OUR hardness thus is resistance to the above named factors.

Designated as Official Publication by the Wire Association

1. Wear Caused By Violent Friction, etc.

AS we know, the diamond crystal is made up of carbon atoms arranged in a symmetrical order and bound together by a phenomenon called crystallization. Each atom is equally nearest to four atoms to which it is bound. It matter not to us here how this binding works, but we find that the wear progresses by the wire tearing off atoms or clusters of them from the surface of the canal and so the hole is enlarged. This is the normal and theoretical process of wear.

✦ ✦ ✦

IS there a difference in the strength of the binding between atoms in different stones, and thus are some stones more resistant to wire drawing wear as far as diamond structure itself is concerned?

✦ ✦ ✦

PERHAPS, but let me state emphatically, and this is important as we will see later, that science has up to date not supplied us with any method that enables us to test such variations or even be aware of them. So that, strictly speaking, there is no foundation in fact for the claim that diamonds from one origin are harder than those of another due to structural differences. I will take up this important subject further.

✦ ✦ ✦

2. Centrifugal Stress Created By the Elongation, etc.

THE stress caused by the wire being pulled through the tapered hole and which tends to split the stone in two according to the line of least resistance is a recognized fact. Is there a line of least resistance in the diamond structure? Yes, there is. It is along the cleavage planes. There are four such planes. They can be detected quite easily, for they are parallel to the faces of the octahedron (perpendicular to the four ternary axes).

✦ ✦ ✦

WE have seen that the diamond lattice is made up of atoms equally distant from four others as if the atom occupied the center of gravity of a triangular pyramid with the four others placed at the four apexes. Now, if we can visualize a sizable structure made up of such pyramids, we will find that there are four directions in which planes can be drawn which will meet fewer bonds between atoms than in any other direction.

✦ ✦ ✦

THIS weakness is thus inherent to all diamonds, irrespective of origin, and as it is a directional weakness, its effects can be overcome by keeping all these planes at equal angle to the direction of the drawing stress.

✦ ✦ ✦

I PATENTED this process (which is now public property) some 12 years ago. I may add that since that time hundreds of thousands of dies drilled according to this principle have given conclusive proof of the effectiveness of the method.

✦ ✦ ✦

HOWEVER, despite our ignorance about the mechanics of the binding between atoms, we have knowledge of variations existing in the bonds between lattices along the cleavage planes due to various causes such as post-crystallization alterations, weakening of the structure by interference of foreign matter, etc.

✦ ✦ ✦

THIS is thus a variation in the brittleness of diamonds. As we will see, these variations are common to stones of all origins. Fortunately they have left an imprint on the crystal in the shape of characteristics which will permit us to distinguish the good from the bad.

PAUL L. HERZ
Consultant and Diamond Die Expert. Formerly Technical Advisor and Manager, Belgian Tool Company, Malines, Belgium.

✦ ✦ ✦

I can therefore sum up our definition of "hardness" as resistance to wear coupled to a low coefficient of brittleness. And it will be in this sense only that I will use the word "hardness" in this article.

✦ ✦ ✦

The Claim of Differences in Hardness in Diamonds from Different Origins

THIS style of classification rests upon a belief handed down to us from times immemorial.

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THE origin of the claims of great hardness goes all the way back to the very first mention of diamonds in the scriptures. (Jeremiah XVII) One of the famous Romans (Pliny) vaunted their hardness, which was hailed as their greatest virtue. Much later the great French traveler, Tavernier, wrote in the same sense.

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THE first diamonds are believed to have come from India until their discovery in Brazil in 1728. Some of the early chroniclers reported the greater hardness of Brazilian diamonds as compared to those from India.

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THE source of information, in those days, was the diamond cutter who labored painstakingly for weeks and months, and even years, before he turned out a polished gem.

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THE learned men of a few centuries ago who were the first to take a real interest in diamonds, such as the illustrious Buffon, also referred to the expert testimony of the cutters to prove the hardness of the diamond. Diamond cutters remained our only source of information up almost to the present days.

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THE real value of their testimony can best be gauged by scanning through their contemporaneous opinions. It shows that

since the great South African "boom", every newly discovered diamond was claimed by them to be harder than the preceding ones.

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WHEN, after the discovery of the Kimberley diamonds, came those from the Bultfontein mine, the cutters claimed that the latter were much harder than the former and demanded increased pay for cutting them. When the Jagersfontein stones were brought into the market, these also were claimed to be harder than the Bultfontein and extra pay was demanded for cutting them. Later on, with the discovery of the Premier (Transvaal) mine, cutters at first refused to work these stones, claiming them to be altogether too hard. Recorded proof of this could still be found in the annals of the Diamond Cutters Unions of Antwerp and Amsterdam from which one will find that an additional 10% was exacted for the cutting of Premier stones.

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SOME years later, when the first Belgian Congo diamonds were brought out for cutting, these were accused of being harder and all previous demands for extra pay on the Premier stones were dropped and the Congo diamonds drew the high tariff.

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DIAMOND wire drawing dies entered the picture at a comparatively recent date and the selection of stones for dies was entirely influenced by the prevailing belief in hardness by origin. But by that time diamonds had also entered the other industrial fields and Brazilians were reputed to be the best industrial stones.

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THE primary reason was that Bahia yielded a wide mixture of poor colors of little value for gem cutting, particularly since the advent of the South African fields, where good colors were plentiful, and that dealers naturally oriented the totally unsaleable lots of Brazilian stones towards the new outlet, which was industry.

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THERE is another reason for the preference shown by the die makers for Brazilian stones. That was because the normal output contains a larger percentage of round shaped stones than any other source of production.

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PRACTICAL experience has not supplied us with the slightest proof that Brazilian stones are harder than any other due to their origin. So far it can be said that no real comparative test has been made.

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IF such a test were to be made, here are the factors which would necessarily have to be taken into account:

The certainty about the origin of all samples.

Identity of shape and quality as determined by the various physical characteristics.

The drawing of wire under identical drawing conditions.

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THE test would have to cover the use of a great number of dies, let us say a hundred each per origin, in order to even up the sources of error due to the irregularity of the drilling.

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WE know that the drilling is approximate as to the proportions of the various parts of the canal, the exactitude of the angles, etc. Such a test has never been made to my knowledge.

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I KNOW of some tests which have been made in other industrial fields, such as wheel trueing, which is "abrasion", a form of wear somewhat similar to ours, but the very details of the experiment as published preclude their acceptance as convincing.

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AS a final argument, I want to remind those who believe in hardness by origin, that, as they well know, each origin, whether field or mine, produces diamonds of all colors, sizes and qualities and that the Bahia fields also yield large pieces of bortz which are soft and gritty. The same applies to the once famous black Jagersfontein stones, very much sought after for dies.

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THE conclusion is obvious. We cannot base our selection upon anything but the physical characteristics of each stone, irrespective of origin and this permits us, now that we have rid ourselves of the shackles of prejudice, to eliminate unsatisfactory stones as far as science, experience and logic supply us with the evidence of their shortcomings. We can thus establish certain rules which can be used as a practical criterion of selection.

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Rules for Selection

1. Absolute Purity

DIAMONDS are usually impure. It is estimated that less than 4% of the diamonds mined are free from impurities.

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THE word impurity covers all known defects such as spots, cracks, air bubbles, piques, inclusions, imperfections, feathers, etc. The reason why such impurities are fatal to dies is quite simple. Any kind of an impurity amounts to an interstice or a small crevice which is a space with no binding between atoms. The swift passing wire will forcibly inject metal shavings, lubricant or dirt right into this open space, no matter how small it is, and the flaw will eventually spread along the line of least resistance (cleavage plane) until the diamond splits in two.

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THE notion that the diamond is the hardest of all minerals blinds us to the fact that it breaks so easily. I know of nothing that illustrates it better than the art of the diamond cleaver.

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WHEN a diamond is to be cleaved in two it suffices to cut a thin "V" shaped groove into a ridge on the skin with a small sharp-edged diamond splint. One then inserts a blunt steel knife into the groove and a light tap on the knife will split the stone in two with a smooth and mirror-like break.

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IF the groove is carefully made in the exact direction of the cleavage plane, the force required for the cleaving is insignificant and a stone of one hundred carats will split as easily as a small one of, let us say, ¼ carat.

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ALL impurities are like ready-made grooves into which the

passing wire packs grime or lubricant until the split occurs. If one examines any kind of an impurity with a strong loupe one will invariably discover that many crevices radiate from it along cleavage planes.

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I INSIST on the wisdom of rejecting stones with any impurity no matter how small or how far it is located from the bearing of the die.

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DIAMONDS with one impurity are almost certain to have hosts of others invisible to the naked eye or even to the loupe.

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IMPURITIES in diamonds are seldom single incidents but rather results of a general condition prevailing at the time of crystallization, and the chances are strongly against them being single. Microscopic impurities are hardly any better than visible ones, except that the die may run for a little while longer before breaking up.

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2. Selection of Shape

IF we could make the diamond synthetically we would no doubt give it an ideal form similar to the carbide die nibs; that is, a cylinder with the base about one and one-half times the height.

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BUT we must accept the shapes as made by Nature and the best we can do is to select those approaching in form the carbide nib. The best prevailing forms available would be the octahedron with a pronounced rounding of the edges and apexes so as to look like a slightly flattened ball.

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WHEN appraising a stone for shape, one should try and vizualize how large a nib, as described above, can be inserted in it. Whether the diamond is meant to be flattened beforehand, or set in its natural state, does not matter, for high sides at inlet or outlet should be avoided in either case.

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3. Rejection of Stones with Two Enlarged Crystal Faces

WHEN two of the eight crystal faces are unduly enlarged, the lay of the stone impels the using of these faces for flats so that the canal will be perpendicular to them. In that case the drawing would occur at right angles to the cleavage planes with the result that the narrowest part of the bearing will chip off and wear unduly fast.

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4. Rejection of All Stones Showing Single or Multiple Twinning Whether Partial or Not

STONES showing twinning are also called spinel twins, naats, maacles, cross-naats, doublets or knotty stones. I can best describe them by saying that they look as if a crystal had been split in two then resoldered together after having rotated one of the halves some 60 or 120 degrees.

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MOST twins have two larger faces parallel to the twinning seam so that normally the drawing would be perpendicular to the seam and this seam will show up as a "ring" in the canal.

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I NEED not enter into the difficult theories on twinning but experience has shown that the "twinning seam" is most of the time impure and is definitely a weak binding between the twins. When stones have polytwinnings like the "cross-naats", the defect is even greater.

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5. Rejection of All Stones Showing Slip Planes

THE presence of slip planes is shown by slight elevations on the skin running parallel to the cleavage planes. They may be single ridges or running in series. Very often they are not continuous but extend only over and around part of the stone.

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ONE might be inclined to ignore them because, notwithstanding, the stone may be pure and homogeneous throughout.

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HOWEVER slipping produces the same weakness as twinning and in theory the mechanism of twinning, or slipping, is the same and differs only in this respect: that the atoms are transferred not to symmetrical positions, but to equivalent equilibrium positions. In fact the phenomenon is accompanied by added brittleness.

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6. Rejection of Sharp-edged Stones with Flat Crystal Faces

THESE stones are often identified in the trade as "crystals" or "squares". They are octahedral; the faces are smooth and flat, often respendent, and intersect in forming sharp edges and pointy apexes. Practical experience shows them to be hard, but very brittle and sensitive to shock. Diamond cleavers will tell you that "crystals" require but a very light blow to split and that furthermore the chipping of flakes off the cleavage planes can be done with great ease. This is a sign of brittleness.

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I WILL add that when the cleaving groove is not well carved out and oriented, the splitting of the "crystal" requires a harder blow, which it will not withstand, and it is likely to shatter into pieces, instead of cleaving. This is not the case with roundfaced or roundedged diamonds.

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DOES theory explain this condition? Not clearly, because we know as yet too little about the value of interatomic bonds. I do think, however, that brittleness is due to the altogether too orderly arrangement of the atoms, hence the greater ease of separation between rows.

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MANY things confirm this supposition: Firstly, the flat, highly brilliant octahedron faces intersect along sharp straight lines, and this denotes an orderly arrangement of the atoms. Secondly, stones of that type take on a high polish with great ease, in the course of both diamond cutting and die polishing. Thirdly, when subjected to specific industrial tests devoid of shocks, "crystals" show hardness equal to that of other diamonds.

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HERE are two practical tests showing the equal hardness (not in our sense however): Small "crystals" are successfully

used for precision thread grinding. This work, although delicate and free from shocks, is very tough. Small "crystals" can be used satisfactorily in the making of fine dies (.002 and finer) for drawing very soft metals (copper, silver, gold).

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7. Rejection of "Dull", "Frosted", or "Corroded" Stones

ALL these appellations are autodescriptive and apply to the same type. The same cleavers test as applied to "crystals" shows that "corroded" stones are very brittle. I had come to the conclusion a long time ago that this corrosion was brought about by oxidation and took place as a result of an elevation in temperature, such as took place many times during the thousands of years the diamonds were imprisoned by the magma.

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RECENT new methods of investigation of diamond structure by means of Raman spectra, permit us to state that when the diamond is heated, even at low temperature, the lattice slowly elongates towards the pattern of graphite to which it will turn eventually, thereby loosening the bonds between layers. This, of course, amounts to an increase in the brittleness.

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INCIDENTALLY, it also proves what I have contended for many years, that heat deteriorates the diamond and that thus exaggerated drawing speed which generates a very high surfacial temperature in the canal, is a cause of rapid wear.

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8. Avoidance of Stones with Color

THIS title may well elicit remarks about the "cheapness of advice" because for commercial reasons, pure white stones are not available for die making on account of their higher value for gem cutting, leaving no choice in the matter.

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BUT it makes the need for guidance more imperative because satisfactory stones will have to be selected from among the unsatisfactory ones available.

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PHYSICISTS class the diamond among the "allochromatic" minerals, which means that the color is not a part of the crystalline structure, but is present in it as a pigment or as an inclusion of submicroscopic particles. The coloring pigment is thus nothing but a submicroscopic impurity.

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THE effects of such impurities on hardness range all the way from added brittleness to easy wear due to the tearing away of the particles not normally bound to the structure from which they are separated by the pigment.

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IN other words, color of any kind decreases the "hardness". We must however not take for granted that hardness decreases proportionately as the pigmentation increases.

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WHILE our hardness is necessarily affected by the volume of the pigment particle occluded in the stone, the depth of the coloration is not necessarily proportionate to that volume, because many other factors come into play.

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FOR instance, certain fine light browns are definitely more brittle than the darker brown. We do not know as yet the exact nature of the various pigments, but experience has taught us that some pigmentation is detrimental to hardness, and I purpose to list them carefully farther on.

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GENERALLY speaking the most uniformly hard colors are those running from the white into the lighter shades of yellow. Next come those running into the browns. Brown and yellow tints are in the majority among the non-white stones.

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10. Rejection of Blue-White Stones

BLUE-WHITE diamonds have the highest commercial value for gem cutting. But it should be borne in mind that the bluish tints, no matter how faint, are the result of pigmentation.

MANY of these blues, particularly the over-blues, the smokey blues and the petrol blues are extremely brittle and may even develop cracks as early as during the drilling of the stone.

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11. Rejection of Dull, Grey, Blackish, Black, Milky or Murky Stones

A SPECIAL warning should be given against this type, no matter how homogeneous it appears to be, for some of them enjoy a reputation of great hardness and toughness in industrial diamond circles. They are sometimes referred to as Jagers greys or Premier blacks or greys. They may be tough for special grinding purposes where toughness and abrasive qualities are a virtue but they are unsatisfactory for dies.

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12. Rejection of Multicolored Stones

STONES with double coloring like brown and yellow, yellow and green, yellow with an oily luster, brown with a gasoline or oily luster, etc., are very brittle. These additional hues bring about a condition of great brittleness.

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13. Rejection of Stones with An Uneven Distribution of Color

SOME stones seem darker at one end than at the other, while in others the coloring increases to a point where it becomes a patch of concentrated pigment. They are particularly unstable and brittle.

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14. About "Coated" Stones

THESE are identified by an outer coating or envelope, resplendent, highly colored in various bright hues, which assume interesting patterns. The crystal remains, with very few exceptions, perfectly translucent, permitting an examination for purity.

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INTERESTINGLY enough, the color of the coating is independent from that of the stone, which may have any color known in diamonds. Most of these stones are found in the Matto Grosso district of Brazil and are commonly known as "Bahia diamonds". Some of the aspects are the following:

Green algae color and pattern.
Yellow with green or garnet-red polka dots.
Brown with green or garnet-red polka dots, and any combination of the above named colors or patterns.

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THE thickness of the coating varies between that of a thin veneer and a peel comparable in thickness to the skin of an orange. This appraisal of thickness holds good for stones of about 1 carat, because the thickness of the coating is more or less constant. It is therefore inadvisable to use stones of small weights when the coating is thick.

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THE coating can be cut away easily and it is preferable to cut a "window" or facet on such stones to ascertain their purity.

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I HAVE always held that the coating did not affect the hardness any more than it did the original color of the stone, and although industrial experience in the matter has been entirely empirical, whatever we have gained in knowledge from it confirms this view.

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HOWEVER, the veil of mystery which surrounds the occurence of these markings may have been lifted by recent developments. I have had several diamonds exposed to a cyclotronic bombardment of deuterons. As a result a green coating, in some ways similar to the Brazilian types, covered the stones. The diamond did not seem otherwise affected.

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WHATEVER dissimilarity exists between the natural and the synthetic coating can be explained by the fact that our bombardment was done under certain specifically chosen conditions (mass and velocity of particles, time of exposure, etc.), while the natural coats may have been caused by a variety of radiations under entirely different conditions. Any possible combinations of conditions being possible in nature we may therefore assume that the markings might assume any aspect, pattern or color.

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IF thus one finds that the crystal possesses, in spite of the coating, all other requisites for being selected, it can be considered good for die use.

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15. Partial or Total Skin Coloration (Without Designs) of Uniform Tint

THE Bahia as well as all other sources of production sometimes yield stones with coats uniformly yellow, green, olivine, or sulfate of copper blue. When these stones are resplendent, well crystallized and obviously clear, one can recognize that the coloration amounts to a very thin coating of finely diffused pigment. These stones should be appraised as if the coloration did not exist.

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LIKEWISE many fine crystals of South American origin, of the Premier (Transvaal) mine and of the recently exploited French Africa fields, as well as other sources, show a partially diffused green skin coloration. At times the shade is so light that one only becomes aware of it when many stones are bunched in one lot. This does not impair the hardness in the least and it is very likely that the coloration is due to radiations.

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16. Rejection of Stones with a "Rind"

THE "rind" is a thick, opaque, smokey or milky outer portion of the diamond comparable to the hull of a walnut. Most of these stones come from the B.C.K. district of the Belgian Congo and are responsible for the poor reputation given to Belgian Congo stones as industrial diamonds.

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EVEN when the core is sizable and visibly pure, such stones are to be rejected because of their great brittleness. The temptation to use them is great because they are plentiful and very cheap. Whatever the origin of this heavy "rind", everything points to the fact that these diamonds have suffered alterations due to elevations of temperature in the magma after final growth.

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17. "Water" or "Mine" Worn Stones

SO as not to mistake these stones for the "dull", "frosted" or "corroded" stones already mentioned, I would describe "worn" diamonds as resembling those grayed by lapping or grinding.

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AS the wear may have occurred though rolling on sandy bottoms, travelling in muddy streams or during massive earth movements, the edges and apexes will show the greatest effects of the wear. Some stones are worn to ball-like roundness while others may have reacquired a dull luster.

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BUT "dull", "frosted" or "corroded" stones show definite signs of oxidation, which affect flat surfaces and protruding edges alike. Ofter these "corroded" stones have waved skins, the crest of which still show signs of the luster that belonged to the original skin. This could not be possible when the stone is mine or water worn.

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THE claims often heard that wear markings are proofs of the softness of the diamond are entirely unfounded. The presence of signs of wear are proofs only that the diamonds have travelled, and the degree of the wear is above all the function of the length of time the process lasted, as well as of the hardness of the minerals against which these diamonds were pressed.

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IF it can be recognized through the wear marks that the crystal possesses all other qualifications for selection, wear signs should be ignored.

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18. Stones with "Rippled", "Crinkled", "Corrugated" or "Etched" Skins

MANY stones have a skin which instead of being smooth and brilliant appears tormented and wavy. This sometimes reaches proportion of a heavy corrugation with deep grooves, wrinkles or folds.

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WHEN crinkles or ripples are slight they are probably signs of the alternate growth and solution, which marked the end of the crystallization period. In that case, especially if the stone is still

clear and transparent and has all other good features, one cannot be far wrong in using it, particularly so, when available in very good colors.

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HOWEVER if the grooving is deep or the etching strong, these are probably post-crystallization injuries in which elevation of temperature played a part and this undoubtedly injures the structure so that it is safer to reject them.

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THE line of demarcation between good and bad is closely drawn and it is a matter of individual judgment to know how far to go in rejecting them.

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19. Rejection of Stones with "Glassy" Appearance

DIAMONDS in general, and particularly those with smooth resplendent skins, have a distinctive luster which is so familiar to those accustomed to handle them that they can tell at a quick glance a diamond from any other mineral no matter how well they may resemble each other.

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YET some diamonds, especially the very light brown types, have a "faint" glassy appearance. They have a suspicion of pink coloring. This type is extremely brittle and it is the nature of the pigment which is possibly responsible for it.

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20. Rejection of "Cubes"

CUBE-shaped diamonds used to be a great rarity until the discovery of the B.C.K. (Belgian Congo) diamond fields. Most of them have a heavy opaque and murky 'rind" and are therefore to be turned down. Their prevailing colors are dull white, greenish or yellowish. But there are some clear white or yellow cubes which one is tempted to use for dies on account of the advantageous form and the rather low cost.

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I HAVE made extensive tests with them in the drawing of both copper and steel wire and the results were definitely poor. So poor, in fact, that it was found unnecessary to make comparative tests with other types of diamonds.

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STRANGE to say, contrary to the theory, cube shaped diamonds are freaks of nature, although diamonds do crystallize in the cubic system, their common form of crystallization is the octahedron.

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IT has been my privilege over a period of years, to have seen diamonds as they came from their sources of production from, I believe, every origin known, and it is somewhat of an aphorism to state that the octahedron is the normal form of crystallization carbon.

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HOW then do these cubes occur in quantities of the B.C.K. fields? They show conclusive evidence of having suffered post-crystallization alterations which impaired the structure and brought about brittleness.

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THESE cubes were obviously not born as such, but acquired their shape as a result of the solution of the hard angles or apexes.

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21. Determination of Diamond Weights for Size of Hole

THE selection of the right size stone for a given hole is a purely economic question within certain limitations imposed by logic and practical reasons.

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THIS question has been raised in this journal every now and then (August, 1942, p. 402; December, 1942, p. 717).

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THE keeping secret by the die maker of the weight of the diamond is childish, but I will admit that the giving of the weight is meaningless unless it is accompanied by a true description of shape and quality. When weight is given it represents "rough weight", that is, what the stone weighed before being drilled, and this adds to the confusion because the percentage of loss incurred can be very elastic.

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IF stones are properly flattened, they will, according to shape, lose in average 20% of the original weight, with a low of 7% and a high of 30%.

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IF drilled unflattened as is the case when the diamond is set in a nib before being drilled, the normal average loss is 7% with a low of 5% and a high of 13%.

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IN the latter case, the die maker is unable to give the net weight while in the first case he is afraid of giving it because it allows unfair competition to supply lower grade stones or poorer shapes at a lower rate per carat.

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BE that as it may, the only real safeguard the users have is to proceed as follows:

1. **Choose two or more reputable makers among whom the orders will be divided equally.**
2. **Order dies with weights given by you and appropriated to your particular working conditions.**
3. **Give the die maker sufficient time to do a good job and if possible give tentative orders long ahead of time. This will also ease his diamond selection problem.**
4. **Pay a fair price for good dies and disregard competitive price cutting. There is no such thing as cheap dies.**
5. **Check production of dies as well when new as after each repolishing.**

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BEFORE discussing the economic aspects of the problem it is well to list some of the practical limitations affecting weights.

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22. Practical Limitations Affecting Weight of Diamond

A. The weight must be sufficient to withstand the stress of the largest size wire which you expect to draw in normal quantity through the die.

B. Do not get the idea that because the quality is good a die can be recut indefinitely until the stress limit is reached. The stress of drawing slowly deteriorates the diamond in various ways and so does the repolishing. As an example I suggest, for instance, that when drawing high carbon steel wire no provision for extra weight should exceed the possibility of four repolishings.

C. The weight should be function of the total height of the drilling (inlet, reduction, bearing, outlet), which in turn depends on the size of the hole. There

is a normal clearance for excess weight for initial size which should thus never be exceeded. If, let us say, a one carat diamond is used instead of a ½ carat and the die maker has to cut out a lot of surplus diamond and lengthen the inlet and the outlet unduly, because both the reduction and the bearing have a constant value. This will add to the cost of labor and is not conducive to good workmanship. Besides, after a few repolishings the die will need complete reshaping which is a costly operation.

D. Do not try to save on the cost of the diamond when weights range below 0.25 carats per stone. The value of the diamond decreases but very little and the cost of labor makes up the greater part of the die cost which is practically the same whether a stone weighs ¼, 1/5, or 1/6 of a carat.

E. Even if allowance for stress permits the lowering of the weight it must be borne in mind that stones below 0.15 carats become awkward to handle and therefore the quality of the workmanship suffers. Besides, setting becomes more difficult and the stone will be less securely held.

F. When it comes to capillary sizes it is inadvisable to reasons explained above to go either below 0.12 carats and above 0.16 carats.

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23. The Economic Aspect of the Weight Problem

AS a basis for discussion I reprint the list published in this journal in the August,1942 issue, p. 402.

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THIS table is good only for users having identical manufacturing problems to those using it. As **practically every user has a different economic problem to solve it is impossible to establish a unique standard of weights.**

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THESE problems are influenced by the following factors:

a) The nature of the metal drawn.

Standard Weight for Diamond Dies

Size	Ave. Ct. Wt.
.0013 to .0016	.15 to .20
.0017 .0021	.20
.0022 .0025	.20
.0026 .0028	.20
.0029 .006	.20
.0061 .0099	.25
.010 .0113	.27
.0114 .013	.30
.0131 .0142	.30
.0143 .016	.35
.0161 .018	.40
.0181 .0205	.45
.0206 .023	.50
.0231 .0253	.55
.0254 .029	.65
.0291 .032	.70
.0321 .036	.80 to .90
.0361 .041	.90 1.10
.042 .046	1.10 1.25
.047 .052	1.25 1.40
.053 .058	1.40 1.60
.059 .065	1.60 1.75
.066 .073	1.75 2.00
.074 .082	1.80 2.25
.083 .091	2.00 2.50
.092 .102	2.00 2.50

b) Range of the sizes drawn with diamond.
c) Importance of finishing sizes.
d) Tolerance in size and roundness.
e) Method of work.
f) The kind of care given the dies.

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LET us examine these factors in detail.

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a) Nature of the Metal Drawn

WE can for practical purposes divide all wire roughly into four groups, according to hardness, harshness or a combination of both.

1. **Soft wires (electrolytical copper, silver, gold, etc.).**
2. **Harsh wires (phosphor bronze, platinum, certain alloys, etc.).**
3. **Hard wires (hard bronze or brass, ordinary steel, certain alloys).**
4. **Harsh and hard wires (high carbon steel, chrome nickel, tungsten, monel, special alloys, etc.).**

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THIS classification of metals is of course not done in strict terms of physical properties such as Brinell hardness or the coefficient of tensile strength, etc., but rather in terms of diamond wearing potentialities.

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THIS combines harshness of surface or abrasive value, which causes the wear on the die with Brinell hardness, which increases the stress.

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THE more harshness and hardness we have, the more we have to increase the weight of the diamond. Increased harshness requires a longer bearing and a heavier stone, and increased hardness increases the stress and requires in turn a heavier stone. Supposing we have to draw, let us say, a .014 wire of each of the four groups. Here are the weights I suggest:

	Rough Wt. carats
1. Electrolytical copper	0.25
2. Phosphor bronze	0.30
3. Brass	0.40
4. High carbon, high tensile steel	0.50

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I AM taking .014 wire as an example, because it is a size drawn with diamond in all metals. However, particular conditions will cause us to alter this table as we will find out later.

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b) Range of the Sizes Drawn with Diamond

THE range of the use of diamond dies is important. Taking our same examples we imagine four plants with different problems.

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Plant W

DRAWS electrolytical copper from largest sizes down to .002. Our above table suggests 0.25 carats for the .014 die. In this case it is o.k. to raise the weight to 0.30 carats because with careful handling we could repolish the die until it reaches .020 and get a full production at each intermediate size. In using 0.25 carats the stress limit would be reached long before the diamond has deteriorated.

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Plant X

DRAWS phosphor bronze from .022 down to .008. Phosphor bronze wears the die much faster than copper and the stress limit is reached long before that of copper on account of greater hardness. But X needs a lot of .008 finishing dies and buys these dies in fairly heavy weights so that many reach .014 size. However, from that point on the problem is to avoid as much as possible the purchase of dies above .016. The purchase of new .014 dies capable of being recut up to .020 is advisable.

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OF course the weight will have to be increased to let us say

(*Please turn to Page 140*)

Relationship of Overtime to Cost

By K. Bernard Wise,
West Wickham, Kent, England

A subject of intense interest at the present time is discussed here from the standpoint of a British producer. Comments are invited. ✦

THE advancing scale of output of the factories in the U. S. A. has involved the employment of many hundreds of thousands of people on overtime. Owners of factories find such a step to be essential if the impetus given by Government contracts is to be maintained. While the employment of operatives on overtime is welcomed by both plant owners and workmen, the execution of overtime work does not necessarily carry with it increased earnings to the principal unless his costs in that direction are carefully and satisfactorily regulated.

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WHEN overtime work is put in hand without the closest possible attention being paid to the additional cost involved, it is economically obvious that the results may not justify the outlay. It is for this reason solely that the outgoings on overtime must be constantly controlled in order that the executives can, at any time, compute whether the rise in their manufactured output is in line with the increased remuneration which they anticipate and which they actually receive.

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COMMONSENSE regard of the question will demonstrate that operatives cannot be expected to work continuously without such continuity of activity being reflected in the quality and quantity of their output. It follows that the longer the hours worked the greater will be the strain on physical and mental abilities, the lowering of which will, in time, affect ability, efficiency, dexterity, and later, health.

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IT is reasonably safe to assume that the early portion of overtime hours will show a scale of production commensurate with that for normal working hours. For example, an employee engaged on certain productive work for eight hours a day will, on an average, attain a standard output of, say, 50 units. Should he put in an additional hour's work, then for that hour his output will keep to that standard basis of 50 units a day. Should operations continue for further hours, the produced units will most certainly show a marked quantitative deterioration, except perhaps, in the final hour of overtime when there is a slight impetus gained from the incentive of nearing the day's end.

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WHILST the first hour shows a continuation of regulated output and subsequent hours demonstrate a decline, the employer must remember that against this augmentation of the total units turned out, there will be the increased cost of remuneration to the employee who will probably require and receive 'time and a half' or, in the case of night and Sunday work, 'double time'. On the 'time and a half' basis alone, the larger output calls for a 50% increase in the hourly remuneration. Continuing this argument for the work entailing still higher rates of pay, it is obvious that overtime costs must be justified either by

a. a proportionate increase in the selling value per unit produced.

or

b. a reduction in overhead charges and/or standing expenses.

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OVERTIME work is justified only in the reduction which is obtainable in the overheads and standing expenses.

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Overhead and Standing Expenses

EVERY factory owner will have reduced his permanent costs to terms of cost per unit produced but there are certain items (omitting those which are peculiar to individual factories) which are of a fluctuating nature and which are not susceptible to regular inclusion in the calculation of the overtime ratio remuneration.

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THERE are for example:—

Permanent costs	Varying costs
Fire Insurance	Part depreciation
Maintenance	Power
Part depreciation	Lighting
Rent and rates	Personnel Insurance
Checking and supervision	

✦ ✦ ✦

THE additional output involved by working overtime will, in part, permit a saving on those charges which are of a varying nature. Overtime is more justified in those departments or sections where overhead charges are preponderantly constant than in those where the fluctuation of charges bears an almost direct relationship to the scale of production.

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Analysis of Overtime Costs

TO establish whether the maintenance of a department or departments on overtime is economically justified requires thorough investigation and a careful analysis of the resultant figures.

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A COMPARISON should be made between the wages actually earned on overtime and the remuneration which would have been paid had the operatives been on a basic rate. Concurrent with this statement should be prepared a table showing the normal earn-

(*Please turn to Page 142*)

Atlantic Wire Company Completes Annealing Expansion

This department now handles all carbon ranges and alloys for bright annealing and decarburization control. ✦ ✦

SEVERAL months ago The Atlantic Wire Company completed the installation of the last annealing unit in their new building and also the installation of a nitrogen generating apparatus. These two units rounded out the facilities at this plant to make this Annealing Department one of the most flexible units of its type in the wire annealing industry in this country, or for that matter, in the world.

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THIS last addition was the culmination of a well laid plan for developing the Annealing Department of this company to take care of a maximum amount of different kinds of wire business. The original layout goes back approximately two years, when the site of the present Annealing Department was only an extra piece of property owned by the New Haven Railroad Company. Plans were made in accordance with the space available to build an entirely new Annealing Department which would house these facilities, together with adequate space for green wire and annealed wire storage. Much thought was given to the quantity of equipment which would be required and this resulted in making the building at that time considerably larger than was contemplated. However, the ideas which **Mr. W. E. Hitchcock, Sr., Mr. W. E. Hitchcock, Jr.,** and **Mr. E. S. Tyler** had at that time about the ultimate size of this department have been well borne out. The actual requirements of their business and the growth of the Annealing Department made necessary by need for special wires for the war program were met by reason of this carefully conceived planning when the new plant addition was made.

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THE initial installation at this plant consisted of two furnaces and six bases as made by the Lee Wilson Engineering Company. Charge size of this equipment is 48″ in diameter, with a piling height of 84″. With this additional installation were included such items as wire loading and stripping machine, spiders, adequate temperature control, and the gas generating and drying equipment for their ordinary product, which at that time was bright annealed, low carbon wire.

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TO fit in with the actual geography of the land available and the existing plant, the Annealing Department was built on two levels. The upper one is on the same level as the Cleaning House and the Wire Drawing Departments and this makes it easy for the green wire to be delivered to the Annealing Department and at this level it is loaded in the stripping machine onto the spiders and can be stored here awaiting annealing space. The lower level of this building contains all of the furnace control equipment, together with such accessories as blowers, all piping, and such other things as testing instruments and spare parts.

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THE installation was made so that the top of the bases sit at the floor level, which means all of the piping was carried in a pit approximately 2′6″ deep and, although it is out of the way, it can be readily seen through the floor grating which is in removable

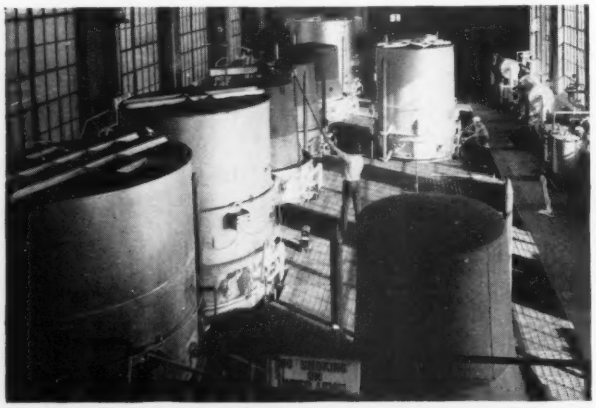

Fig. 1. The entire annealing department—four furnaces and nine bases—control stations to right. ✦ ✦ ✦ ✦

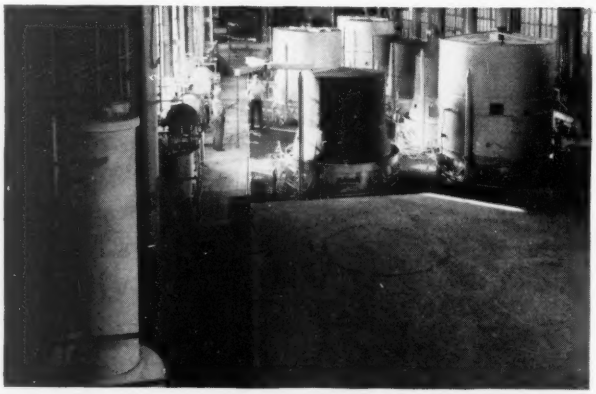

Fig. 2. From the other end of the building. Note two levels and CO_2 stripper in left foreground. ✦ ✦ ✦ ✦

sections so any of the piping can be serviced whenever necessary.

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THE initial installation got well under way and the operators developed experience in handling it so that just about the time everything was running smoothly for the ordinary product, the requirements of war production reached this plant in volume and consideration had to be given the matter of how to handle such materials as 2330 airplane screw stock, 52100 ball bearing steel, and other related alloys and high carbon materials. The problem was, naturally, whether or not the plant should concentrate on this type of material alone and what would happen to their business in common products if they did. The alloy material required fewer bases per furnace than the bright annealed product, so the first move contemplated was to change over the original installation to become three furnaces with six bases, which increased the alloy production by 50%.

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IN order to take care of the common product which still had to be handled, an additional furnace with three bases was purchased, 62″ in diameter, base size, with 84″ piling height. This furnace was large enough to accommodate three stems of 22″ wire, or five stems of 16″ wire, or other possible combinations in loading which at times have been as high as 18,000 lbs. per base. For this installation provision had to be made for obtaining a correct deoxidizing gas for the high carbon and alloy materials. To the deoxidizing gas generator and dryer which had been installed with this large new unit there was added a CO_2 chemical stripper so that the gas produced could be made largely of nitrogen and with just enough combustibles in it to strike a gas equilibrium for handling the materials involved. This installation was completed just at the time the plant had to take over considerable tonnage of 52100 steel and also a large amount of 4037 replacement steel for the 2330 screw stock with which they had had considerable previous experience in handling.

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ONE gathers from visiting this plant that a great deal of practical sense has been used in the handling arrangements for moving the material in and out of the department and in processing it there, also in making the equipment not only easy to use, but respected by the operators since it is so well cared for. The crane operator, incidentally, stands on the floor and handles all of the crane movements with a pendant cord.

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ALL of the piping used in the department is color-coded and kept clean so the operator can tell at a quick, easy glance exactly what pipe and what valve he is looking for in his various operating problems. A great deal of attention has been paid to the safe operation of this department and here, indeed, is exemplified the best use of gas testing equipment to know when the retorts covering the charge are adequately and completely purged and to know when the gas apparatus is making the correct type of gas.

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ONE of the particular problems at this plant is a considerable shifting in the combustion gas analysis and it is only by running continuous records of the gas densities produced by the deoxidizing gas generators that they are able to catch any change in analysis almost before it takes effect; certainly, before it can affect any of the product under the bells. The gas detecting apparatus is of the density measuring type as made by the Ranarex Division of the Permutit Company. Both recording and portable testing apparatus is used so that every base can be checked to be sure the gas analysis leaving that base corresponds with the analysis coming out of the deoxidizing gas generator. Other testing apparatus is always available such as that which is used for taking dewpoints on the gases.

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ALL deoxidizing gas outlets are carefully piped to the outside of the building where the gas is delivered during the purging period. When the bases have been adequately purged, the deoxidizing gas discharges are made in the annealing room but they are lit and observed so it always can be determined that gas is actually flowing through the re-

(*Please turn to Page 142*)

Fig. 3. Control piping for fuel, air, deoxidizing gases, oil for seals, cooling water and cooling air. ✦ ✦ ✦ ✦

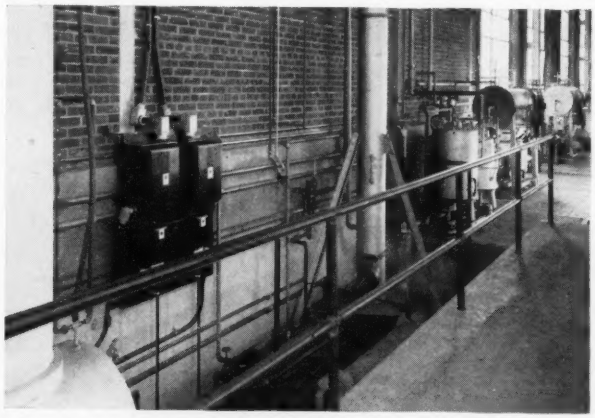


Fig. 4. Deoxidizing gas generators, gas dryers, and CO_2 stripper. ✦

Bore-Grinding Tungsten Steel Cartridge Dies

By E. T. Larson,
Sales Engineering Department,
Norton Company, Worcester, Mass.

The results of laboratory tests on the bore-grinding of tungsten steel cartridge dies are summarized in this article.

TUNGSTEN steels are being used to an increasing extent for the drawing dies employed in the manufacture of cartridge cases for small-arms ammunition. The manufacture, and subsequent reconditioning of these dies, involve an internal grinding operation of more than ordinary difficulty, chiefly because of the unusual resistance of the tungsten steel to abrasion coupled with the fact that in most cases the hole is of small bore and relatively long.

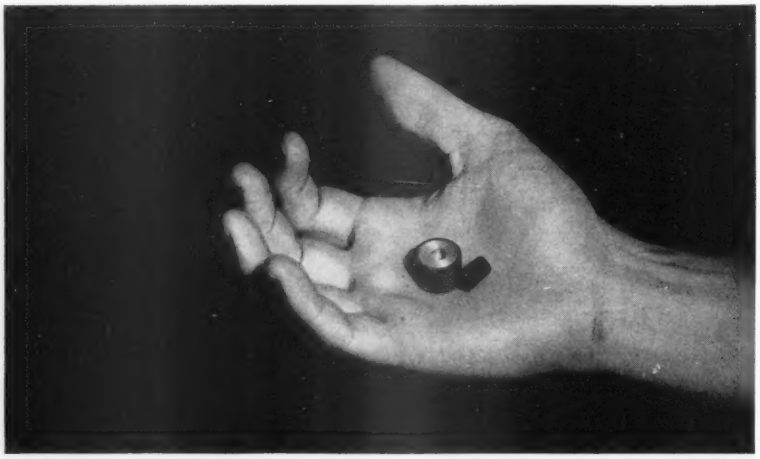
VITRIFIED bonded wheels that will grind ordinary tool and die steels without any trouble, have not proved entirely satisfactory for internally grinding these tungsten steel dies. If the wheels are soft enough to permit the abrasive grains to penetrate the surface, they usually break down so rapidly that dimensional tolerances are difficult to maintain and wheel wear is so great that in some cases several wheels have been required to completely grind the hole in a single die.

ON the other hand, if the vitrified wheels are the least hard, they tend to dull and glaze to the extent that constant dressing is necessary and surface imperfections in the die are difficult to avoid, necessitating a costly lapping operation to remove them. Bell mouthing of the hole and severe springing of the grinding wheel quill must also be expected with the use of hard acting vitrified wheels.

THE problem of finding a satisfactory wheel for grinding the hole in tungsten steel cartridge dies was referred to the Norton Company Research Laboratory. From the wide assortment of wheels of various abrasives and bonds that were tested, it was determined that diamond resinoid bonded wheels gave the best all around results. The findings from these laboratory tests may be summarized as follows:

Grinding Wheels

FOR stock removal, 100S-B100 diamond resinoid wheels are recommended; for finish grinding, 500-B50 diamond resinoid. These diamond wheels can be obtained in any standard diameter, thickness and hole size that may be required for grinding the complete range of cartridge die bores.



Diamond wheels used for bore grinding; the larger one has diamond in periphery and the smaller has diamond throughout.

Speeds and Feeds

THE grinding wheel head should be of a high speed type capable of developing at least 25,000 r.p.m. for wheels up to ½" diameter and 12,500 r.p.m. for larger wheels, up to ¾" diameter.

A WORK speed of 300 to 400 r.p.m. was found to be most satisfactory.

TO permit the diamond wheel to cut properly and also to avoid springing the wheel spindle or quill, the index feed should not exceed .0002" per pass.

A SLOW rate of table traverse —from 20" to 40" per minute —is recommended. This will aid in maintaining a straight hole, free from any bell-mouth condition at the ends.

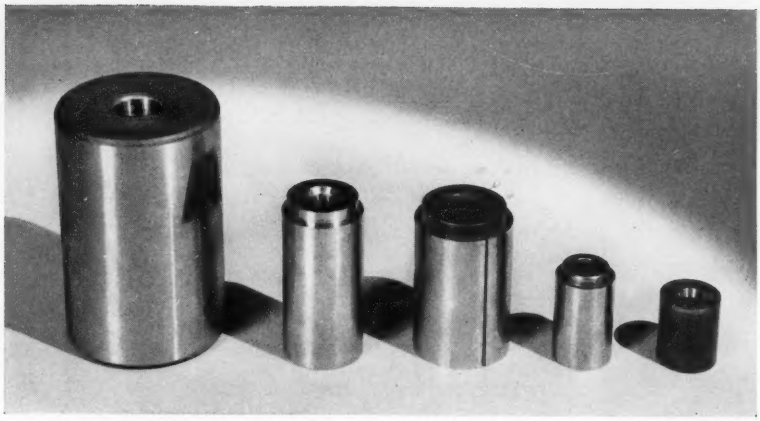
Coolant

ANY standard soluble oil grinding solution may be used provided it is of low concentration (not greasy) and supplied to the diamond wheel in a plentiful amount. There are strong indications that the use of an extra large volume of coolant will reduce the rate of wheel wear as well as promote a faster cutting action.

Wheel Dressing

THE use of either a pumice stick or a very fine and soft **Crystolon** stick for cleaning the diamond wheels is of the utmost importance for maintaining an effici-

Reprinted from the Sept. 1942 issue, of "Grits and Grinds" by permission of the Norton Company.



Typical shapes and sizes of cartridge case dies.

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ent cutting action. Touch the periphery of the wheel very lightly with the dressing stick at the first signs of dulling or loading. We also recommend dressing a new diamond wheel lightly before commencing to grind with it.

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Machine Conditions

THE internal grinding machine should be rigid and operate with a minimum amount of vibration. The bearings should be adjusted closely so that the wheel spindle will run absolutely true. The wheel spindle or quill should be short and rigid and of as large a diameter as the size of the hole in the die will permit. The machine should be capable of providing a slow and uniform wheel traverse and an automatic index feed in increments as small as .0002".

THESE laboratory findings are being confirmed in the field. At one plant manufacturing .50 calibre cartridge case dies, a ¾ x ¾ x 3/16", .00S-B100 diamond resinoid wheel used for rough grinding removed .016" stock in 20 minutes' grinding time from the I.D. of a hardened (65 to 67 Rockwell C Scale) tungsten steel die having a straight hole .784" diameter and 4¼" long.

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THE wheel wear was negligible. The grinding machine was of the suspended wheel slide type, rebuilt and equipped with a high speed wheel head developing 22,500 r.p.m. The work speed was 400 r.p.m.; the coolant, a standard soluble oil solution. The wheel feed averaged .00025" per pass; the table traverse was very slow. The diamond wheel was dressed lightly with a pumice stick at about five-minute intervals.

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THE 500-B50 diamond resinoid wheel used for finish grinding the same die produced a finish of four to five micro-inches R.M.S. There was no attempt to remove any measurable stock and no measurable wheel wear resulted after grinding for approximately four minutes. The adoption of the 500 grit diamond wheel for finishing the hole eliminated much slow and laborious hand lapping.

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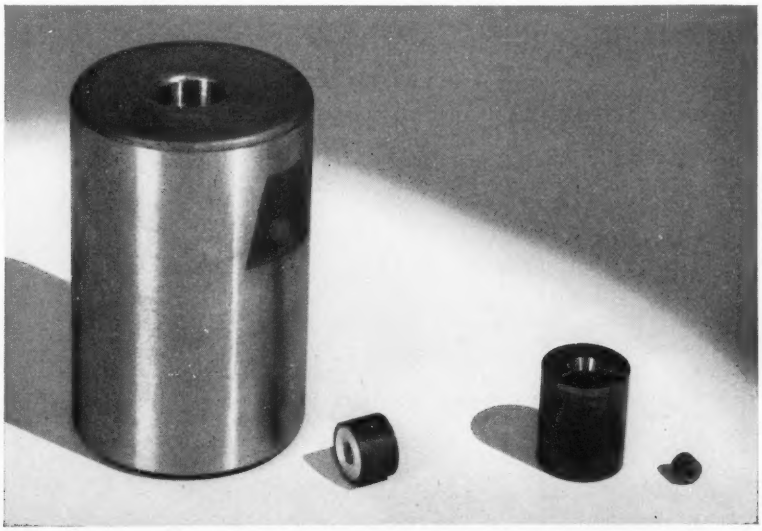
IT is not necessary to use diamond wheels for bore grinding carbon steel cartridge dies or tungsten steel dies in the soft state. These can be satisfactorily ground with aluminum oxide abrasive vitrified bonded wheels.



Large and small dies and the Norton diamond wheels used for grinding the bore of each.

Wire Association Questions and Answers

Copper in Zinc Coatings

In the August 1942 issue of WIRE & WIRE PRODUCTS an article written by Wallace G. Imhoff was published on the above subject. The following letter of comment was received from one of our English subscribers questioning some of the conclusions presented by Mr. Imhoff in his article.

Mr. Imhoff clarifies the questionable points in his reply to this British letter and also brings out some additional information on this subject in his letter of December 9th which follows the first two letters mentioned.

Since the subject is one which should be of interest to the industry the correspondence is published herewith for general information and further comments are invited from anyone interested.

The Wire Association is for the specific purpose of improving production methods. It has been organized as a clearing house of ideas on technical problems and research work in all phases of practical wire drawing and wire working.

The inquiries discussed were received from and answered by members of the Wire Association. These inquiries are sent to the Secretary of the Association who acts as a central clearing point, and neither the names of the firms, or individuals sending in the inquiry, or of the men or firms replying are divulged without permission.

Letter from English Subscriber

"I have read with some interest the article contributed by Mr. Wallace G. Imhoff on the beneficial effects of copper in the Zinc coat on galvanized wires which was published in the August, 1942 issue, of WIRE & WIRE PRODUCTS.

I would just observe that we made some rather exhaustive tests on this subject a few years ago, and so far as corrosion by sea-water is concerned the presence of even small quantities of copper in zinc coats is most deleterious, and results in rapid corrosion and entire removal of the zinc coat. Our enquiry was initiated owing to the rapid failure of certain Trawlwarps and Shipping Ropes which we had supplied. It was found that accidentally the coats on the defective ropes were contaminated with a small percentage of copper, and comparative tests were then made in our laboratory on wires containing copper in the zinc, and wires copper free. The results were most striking and conclusive.

So far as exposure to atmospheric corrosion was concerned, the results were not so conclusive, in fact samples exposed on the roof of our Laboratory in which the zinc coat contained varying quantities of copper up to .6%, did not show after six months exposure any greater loss of coat than wire with a copper free coat. It may be noted that in the wire containing as much as .6% copper in the coat, no evidence of the red stain reported by Mr. Imhoff was recorded.

I mention this point since it seems to me that the introduction of copper in the zinc coat should be approached with extreme caution, and it would not be desirable to jump to the conclusion, on the rather slender data provided by Mr. Imhoff, that it is beneficial."

Reply by Mr. Imhoff

"I heartily agree with this reader, and have so indicated in the last paragraph of my article on page 422 of the August, 1942, issue of WIRE & WIRE PRODUCTS, in which I very clearly make the point, **that the effect of copper in very small additions to zinc coatings is a very fertile field for investigation in research experiments to be conducted by such a recognized authority as the A.S.T.M.**

It was not my intention to create an atmosphere that recklessly adding copper to zinc coatings would improve their corrosion resistance. My first purpose was to see if I could check up my own practical experience, namely, that very small copper additions, with a maximum upper limit of .025 of 1 per cent, are not harmful. Over a period of 22 years in all my research work and practical experience I have personally not been able to find any authoritive references that can give specific and concrete evidence, that copper in zinc coatings at, and below the above cited amount of .025 of 1 per cent is harmful, and does accelerate corrosion; I also have only the records in the literature cited, that in the opinion of many recognized authorities copper in very small amounts is beneficial.

The purpose of my article has already been fulfilled in that it has concentrated attention on this subject, and (1) has already given us some valuable additional information on the subject; and (2) will no doubt start competent investigators to thoroughly and carefully investigate the subject, the same as they did copper in steels, and with same vigor. That is the purpose of my article. I would certainly hope that no galvanizer would foolishly jump to the conclusion that copper is beneficial to zinc coatings, and immediately start adding it in fairly large amounts. I tried very hard in my article to impress upon all readers (1) if added at all it should be done in extremely small quantities the same as in steel; and (2) that the subject of copper in zinc coatings should be one that would give ample interest and reward to their research department for conducting research investigations.

So in reviewing this reader's comment, I do not disagree with him. I think since it has brought comments from him, showing he had some valuable information on the subject available, perhaps if you ask for it in your question and answer column we can smoke out a lot more good information buried away by others—we need this information in our war effort, and I think the subject should be asked in the question columns in such a way, that it will—(1) bring out much valuable data available on the subject, but buried in private files; and (2) many of our large steel companies have research laboratories, and an appeal should be made to them, as well as to the A.S.T.M. to conduct some research in the future on the effect of copper in zinc coatings, the same as they did with copper in steel.

In looking through my article I would like to make some comments. On page 394 with the Table 1 showing the analyses of remelt zincs. One metalware galvanizing company, in fact three metalware galvanizing companies, two in the city where the smelter is located, and another company in Canandaigua, N. Y., all used this remelt zinc carrying copper as shown in this table for years and never at any time have they ever had any complaint that could be traced to the copper content of the zinc. I mention this fact particularly because you will note how very high the copper is in these zincs. This same remelt metal was used in a very large pipe galvanizing plant and I never knew of any complaint coming from them either on account of the copper content.

At the right of the same page you see at the top a galvanizing bath of a very large heater company in Detroit and when I visited their plant as consultant they stated that the metal always carried that amount of copper but in so far as they knew they had never been able to trace any harm to the coating direct to the copper content. I am specific in giving you this information because I want to show you that I did not jump at conclusions, assume that copper was beneficial in all zinc coatings, or just recklessly put out an article to give the impression that copper additions were beneficial. As I stated before, with 22 years of concentration in this one field, I neither had any specific evidence myself, nor could I locate any from anybody else, that proved that copper in very small additions (under .025 of 1 per cent) was harmful. In writing the article therefore the purpose was twofold (1) to bring out in the open all of the information of the subject now available; and (2) to start definite research work by recognized authorities to see what the true facts are. Already we have some fruits of number 1 in this material from your British reader. I really believe we should call attention to his comments on the article, and ask for more (bring out more data and information, if it is available).

On page 395 in the 3rd column at the right of the page you note what Brauer and Peirce have to say; they state up to 5 per cent, but from my own research work, and practical tests I would keep the amount under .025% of 1 per cent, which is less than the amount that will go into solution in the zinc with no discoloration of any kind to the zinc coating.

At the top of the page there is the table of commercial coatings carrying copper as given by Henry S. Rawdon, but unfortunately he does not make any comments at all on the copper content. We also have on page 396 at top of page 'Fourth' in summary—'It is materially retarded by small percentages of copper'. Then in the middle column on the same page we have Prost—'The protective effect of a small amount of copper on the corrosion of zinc is reported by Prost who states that a small quantity of copper seems to have a very protective effect'. And a few lines below we have

Rawdon 'whereas small amounts of copper even a few hundredths of one per cent, appeared to exert a protective action'. All of these comments seem to verify my own limited research and practical investigations.

You will note even in the British comments in the paragraph at the bottom of the page he cites a copper content up to .6 of 1 per cent, did not show any loss after 6 months. I call your attention to the fact that this is 24 times the upper limit for copper that I have suggested, namely, .025 of 1 per cent. The theory that I had in mind was this—that when there is no copper the zinc quickly oxidizes to ZnO, hydroxide, carbonate, and basic zinc salts; but with a small amount of copper in solution in the zinc, this oxidation is arrested, or retarded by the copper.

$Zn + O = ZnO$—(no copper)

$ZnCu + O$—oxidation retarded by small amount of copper.

One thing important has happened which will please us both, the article has set thinking forces into action—and maybe if we drag it out by questions some very valuable data and information will be found to be available, and also that the article will start the A.S.T.M. and other recognized authorities now to conduct some research work the same as they did on copper in steel. There seems to be a complete absence of facts on copper in zinc coatings; it was too bad when they investigated copper in steel, that someone did not think about investigating the effect of the copper in zinc coatings."

1942	Oct. 17	Nov. 2	Nov. 11	Nov. 21
Iron	.045%	.035%	.04%	.05%
Lead	1.00	1.07	1.05	1.15
Aluminum	.70	.63	.....	.50
Tin	.12	.12	Trace	.015
Copper	.04	.02	Trace	Trace
Zinc	98.10	98.12	98.31	98.28

Letter of December 9th from Mr. Imhoff

"The last three weeks I have been away from the office starting up a new hot-dip galvanizing plant that I installed for ship work and defense work in Jacksonville, Florida. On my way home I was called into another very large plant also all production being on shipwork and defense work.

In covering the details of these plants I gathered some additional practical information on copper in galvanizing baths and zinc coatings, which further substantiates the suggestions put forth in my article in WIRE & WIRE PRODUCTS in August, 1942, on that subject.

Here is the analysis of a zinc metal used in this very large plant working on all kinds of galvanized products for the Navy—

Iron	.035%
Lead	1.190%
Copper	.100%
Aluminum	.550%
Tin	.050%

This company has two galvanizing pots —a very large one for large work, and a small one for basket work and small items. Above are some chemical analyses of the galvanizing bath in the large pot—

The chemical anaylsis of a zinc coating on the work showed—November 5, 1942.

Iron	.70%
Lead	.92
Aluminum	.53
Copper	Trace
Tin	Trace
Zinc	97.85

In talking to the superintendent he related the following experience. He said 'Small amounts of copper gave a beautiful job'. Continuing he said, 'Some time ago we got some copper coils from the Bethlehem Steel Co. They weighed about 6,000 to 8,000 pounds each and were about ⅛" thick. The job was a pickling job. We heated the coils and put them in our muriatic acid dip tank and cleaned them thoroughly. The muriatic acid dip took the copper from the coils, and to our great surprise we found the finish of our work greatly improved. This we believe was due to the fact that there was a very thin layer of copper

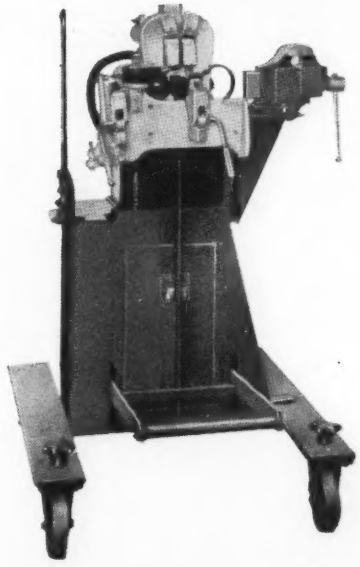
(*Please turn to Page 129*)

MICROMETER PRECISION MICRO-WELD TRADE MARK REG. U. S. PAT. OFF.

CONTINUOUS IMPROVEMENT

MICRO-WELDERS with dial indicating annealing attachments are now available for high carbon wire.

There is positive control of annealing temperature and already hundreds of these special MICRO-WELDERS are proving their dependability and satisfactory performance with leading manufacturers.



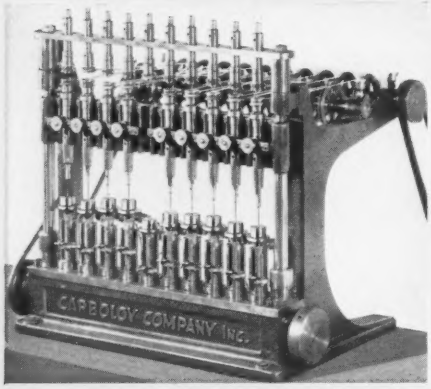
MICRO PRODUCTS COMPANY

20 NORTH WACKER DRIVE, CHICAGO, ILL.

Telephone, State 7468

Complete CARBOLOY TRADEMARK DIE SERVICE

EQUIPMENT FOR FINISHING AND SERVICING ROUND HOLE DIES



Our engineers are prepared to recommend a complete line of die room equipment for all sizes of round hole dies. Many installations already in leading mills.

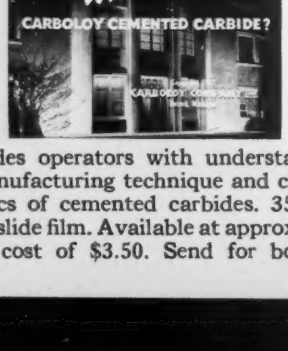
SPECIAL Spring Forming Tools

All types of special guides, arbors, pitch tools and coiling points available for increased life on spring forming and many other wire fabricating applications.

EQUIPMENT FOR FINISHING AND SERVICING SHAPE DIES

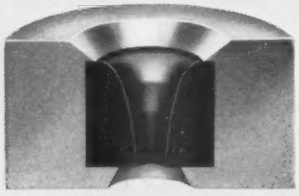
Shape die equipment and accessories for finishing and servicing all types of shape dies up to size 2". Complete recommendations for die room layout and operation.

FILM: "WHAT IS CARBOLOY CEMENTED CARBIDE?" AVAILABLE



Provides operators with understanding of manufacturing technique and characteristics of cemented carbides. 35 mm. silent slide film. Available at approximate print cost of $3.50. Send for booklet.

STANDARD Round Hole Dies for Drawing Wire, Bar and Tubing

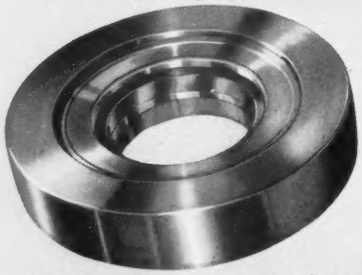

(CROSS SECTION)

Standard round hole dies for drawing wire and bar are available in nib sizes R-1 to R-18 inclusive covering a range of sizes up through 3½" in diameter.

SPECIAL Side Blocks for Sectional Drawing Dies

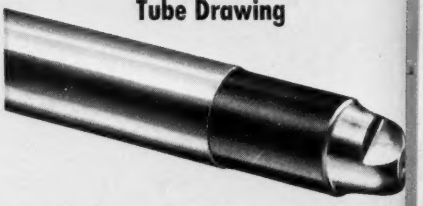
Available in sizes up to 2¼" across flats. Larger sizes can be furnished when conditions for applying are found suitable.

STANDARD Drawing Dies for Steel Shell 20 mm through 105 mm



Standard dies for steel shell up to 105 mm. Special dies for drawing larger sizes, shell nosing, shell case tapering and cupping. Complete line of brass shell dies.

STANDARD Mandrels for Tube Drawing

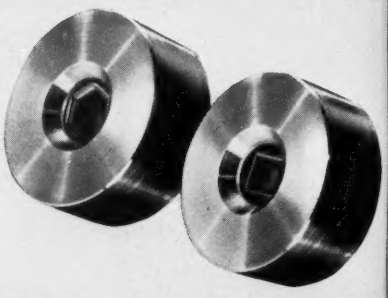


Standard mandrels for tube drawing available in sizes ranging from 0.424" t 2.25" diameter (straight or tapered) Supplied as finished or rough mandrel and finished or rough mandrel nib only Larger and smaller sizes on request.

For wire wear sizes up to

Meeting Carbide Demand 45 Th

STANDARD Square and Hex Shape Die



Standard square dies from hole size 0.146 through 1.605". Hexagons from hole siz 0.146" through 1.980". Special dies i larger or smaller sizes made on reques

An ec drawi up" i suitab for us

CARBOLOY COMPANY, INC., Detroit, Michigan

Authorized Distributors: Canadian General Electric Company, Ltd., Toronto, Canada

Birmi Hartle

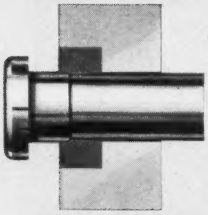
CARBOL TRADEMARK

CEMENTED CARBIDE
FOR WAR PRODUCTION

STANDARD Wire Guide Rings

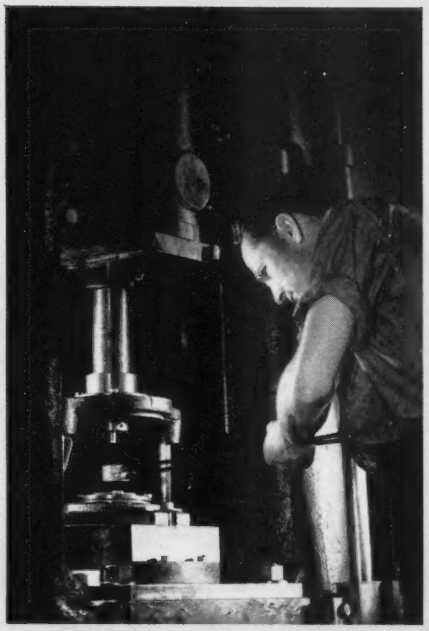
For wire stranding machines or other wire fabricating applications requiring wear resistant guides are available in sizes 0.147″ I.D. to 0.690″ I.D. Provide up to 50 times longer guide life.

STANDARD Boltmaker and Extrusion Dies



(CROSS SECTION)

A complete line of standard dies for boltmaker machines up to ¾ boltmaker size. Other standard extrusion dies from hole size 0.200″ to 1.000″ available.

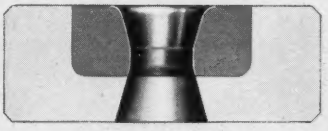


FORGED CASING PROCESS INSURES MAXIMUM SUPPORT

The hot forged casing—a Carboloy die feature—provides maximum mechanical support for the nib, and compressive backing accurately calculated to withstand drawing pressures. Ordinary shrunk or brazed casings provide support at sides and back only. Carboloy forged casings provide support for the nib at the front also; substantially increases both transverse and longitudinal strength of nib.

45 Times Greater Than Pre-War Years

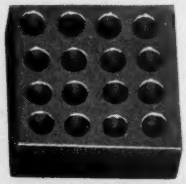
STANDARD .30 and .50 Cal. Ammunition Dies



(CROSS SECTION)

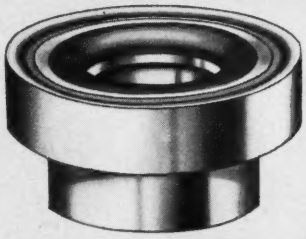
Standard line of small arms ammunition dies for drawing .30 and .50 caliber cartridge cases and jackets. (catalog D-113R)

STANDARD 16 Hole Die Plates for Drawing Wire up to .050



An economical way to provide dies for drawing of fine wire by eliminating "build-up" in larger sizes. Prints available on suitable die holders and locating fixtures for use in conjunction with die plates.

SPECIAL Round Hole Dies



All types of dies for eyelets, sheet metal drawing, sizing operations, welding, rod coating, etc. Available in cemented carbide nib sizes up to 18″ I.D. x 20″ O.D.

NEW CATALOG

A new, comprehensive catalog containing specifications and prices of all major cemented carbide dies and servicing equipment ready about March 1. Your name added to catalog mailing list on request.

Birmingham, Ala., Chicago, Cleveland, Los Angeles, Newark, Philadelphia, Pittsburgh, Seattle

Hartley Wire Die Co., Thomason, Conn., Michigan Wire Die Co., Detroit, Mich.

CARBOLOY CEMENTED CARBIDE

TRADEMARK

STANDARD INDUSTRIAL COMPOUNDS

ARE MADE TO ORDER

Research and practical experience are essential to facilitate production, lower operating costs, and improve quality of product.

Our practical experience and laboratory facilities are at your disposal to serve you to this end. Variation from standard lubricants are sometimes required to attain the maximum of efficiency in speed, die life, and finish.

Wire drawing compounds must provide film strength, complete adherence, and elongate with the wire to the finished size to prevent raw dry spots or scratched surfaces of the steel.

Our service men will gladly demonstrate our products.

Listed below are a few of our standard lubricants, others are listed in the previous issue.

#60

For drawing low and high carbon wire dry on intermediate machines or bench.

#105

For bright wire two or three drafts leaves clean bright finish.

#80

For drawing one hole wire for cold heading finish.

#24

For coating wire where special finish is required without lime. Precoating before lime on wet drawing.

STANDARD INDUSTRIAL COMPOUNDS COMPANY

4600 FERDINAND STREET SIC CHICAGO • ILLINOIS

Government Wire Production Information

Military Exemption List Revised

REVISION of the military exemption list (List C) of the Iron and Steel Conservation Order, M-126, was announced recently by the Director General for Operations in an amendment to the order.

✦ ✦ ✦

THE revised List C sets forth equipment and products permitted to be manufactured of steel and stainless steel for the Army, Navy, Maritime Commission, and War Shipping Administration.

✦ ✦ ✦

PRODUCTS released from the general ban on the use of steel are:

Railings and barriers for industrial use; wire for rat-proofing refrigerator boxes; window shades and rollers for railway cars; lamp manufacturing machinery; spools for wire used in industrial processing; name, date, and instruction plates for machinery and equipment, and box and dobby looms for textile machinery.

✦ ✦ ✦

PRODUCTS or equipment released from the ban on the use of stainless steel are:

Miners' lamps, data and instruction plates, needle valves for stoves, pipe tubes, tubing and fittings, and repair and maintenance materials for baskets.

✦ ✦ ✦

AMONG the products appearing on the military exemption list for the first time are:

Access panels of stainless steel for radio equipment
Certain types of air conditioning equipment
Buckles for clothing
Fence posts
Hose clamps of stainless steel for aircraft
Stainless steel mechanical drawing and drawing equipment.
Motion picture cameras and projectors—stainless permitted for sprockets and aperture plates
Music stands for use on board ship
Motion picture screen stands
Partition studs for radar equipment
Plumbing and heating equipment
Reels, cable, and rope for combat and field training purposes and on board ship
Spools for ink ribbon and wire
Stencils
Tent frames and supports

✦ ✦ ✦

REPAIR and maintenance parts are permitted for the first time for several items on List C. Permission to manufacture some products for military purposes has been delimited to restrict the ex-

REASON for revision of the military exemption list is a recent amendment of the order, which added several score items to the prohibited groups and limited the use of stainless steel after January 5, 1943 for items on the military exemption list. After discussion by Army, Navy, Maritime, and WPB representatives, it was determined that of the items prohibited for civilian use, the ones added to List C were needed by the various services.

✦ ✦ ✦

Electrical Installations to be Curtailed in 1943

INSTALLATIONS of rigid electrical conduit and electrical metallic tubing, flexible metal conduit and tubing, and metal raceways for enclosure of wire and cable, will be much curtailed in 1943 under provisions of a new limitation order (L-225), restricting sales of these products and limiting the amounts of steel that may be used during 1943 in the manufacture of rigid conduit and metal raceways.

✦ ✦ ✦

INSTALLATIONS of metal conduits are prohibited after December 19, 1942, except on projects or locations covered by a preference rating of A-1-j or better and where for purposes of safety it is necessary to comply with certain standard requirements of the National Electric Code.

✦ ✦ ✦

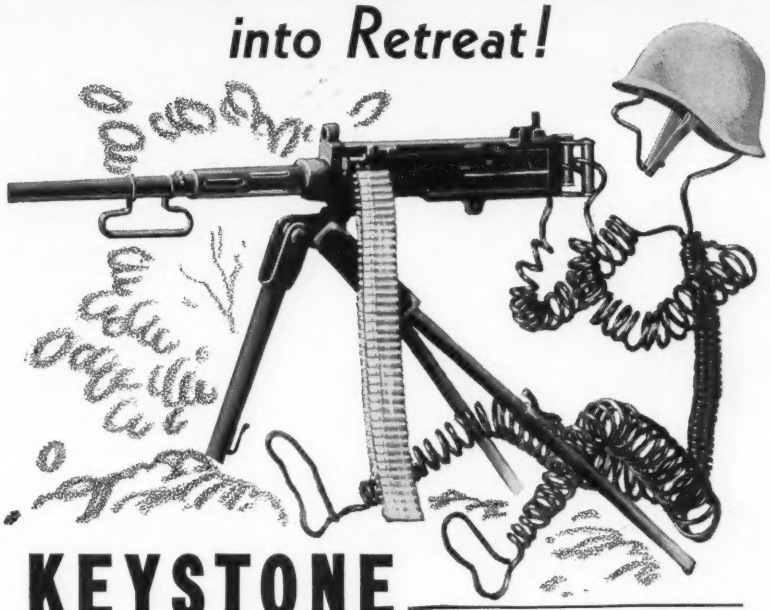
FLEXIBLE metal conduit or tubing may be installed for necessary extensions less than 12 feet in length to connect with electric motors, current consuming devices, or electric control equipment.

✦ ✦ ✦

MANUFACTURE of rigid electrical conduit will be restricted to 40 percent of the total weight of metal put into process for that purpose during the calendar year 1941. Individual producers are prohibited from putting into process during any calendar quarter metal in excess of one-tenth the total weight similarly consumed by them during the year 1941.

(*Please turn to Page 126*)

Helping "Sting" the Enemy into Retreat!



KEYSTONE Wire

Machine gunners — men from your own plant and your own community — are stinging the enemy into retreat with steely courage. Like them, their supporting equipment is *efficient* . . . clear down to bullet cores and numerous gun parts of wire mill production.

Yes, steel and wire mills, like Keystone, are now straining every facility to speed billets, rods and wire into tools for Victory. These items, in thousands of forms essential to planes, tanks, guns and ships, too, are helping support our fighting forces.

Victory is industry's job No. 1. That job must be *completed* before Keystone can again help equip American assembly lines for efficient CIVILIAN production.

KEYSTONE STEEL & WIRE CO.
PEORIA, ILLINOIS

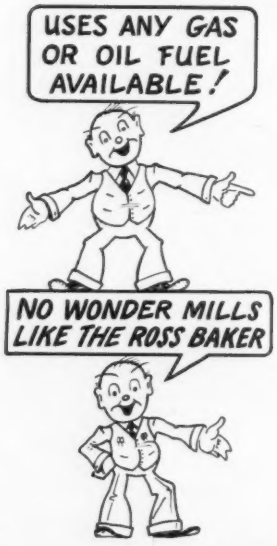
Just a few of thousands of wire mill products for war uses.

Special Analysis Wire for All Industrial Uses

SAMSON SPRING WIRE
KEYSTONE STEEL & WIRE CO. PEORIA, ILL.

New ROSS Wire Baker

SPEED UP the Baking of Wire and Rods



The Ross Wire and Rod Baker utilizes High Temperature Air that is entirely free from all products of combustion. The circulation of this clean heated air not only dries your product in much less time but prevents the rusting often caused by older methods of baking. It insures a soft smooth lime coat that lengthens the life of drawing dies.

Whether your requirements are for a new baker or the revamping of your present unit, write us for full particulars.

J. O. ROSS ENGINEERING CORPORATION

Main Office—350 MADISON AVENUE., New York, N. Y.

CHICAGO—201 North Wells Street DETROIT—12953 Greeley Avenue

ROSS ENGINEERING OF CANADA, LIMITED, Dominion Square Building, Montreal

Government Wire Production Information

(*Continued from Page 125*)

USE of metal for manufacture of raceways may not exceed 50 percent of the total weight of metal put into process for the same purpose during the calendar year 1941. Individual producers are prohibited from putting into process during any calendar quarter metal in excess of one-eighth of the total weight similarly consumed by them during the year 1941.

✦ ✦ ✦

LIMITATIONS on production of conduit and raceways are effective January 1, 1943. Restrictions imposed by L-225 will not apply to conduit, tubing and metal raceways in the possession of an electrician on December 16, 1942, or which had been physically delivered, or were in transit to the site of construction on or before that date.

✦ ✦ ✦

USED conduit, tubing or metal raceways are also exempt from the provisions of the order. Restrictions will apply to both domestic and foreign business except that the order is not applicable to such materials as may be physically incorporated in any implements of war.

✦ ✦ ✦

AN estimated annual saving of 100,000 tons of steel is anticipated. The quarterly base period for determination of production quotas by individual manufacturers was selected because of the fact that the industry operates on a quarterly basis.

✦ ✦ ✦

Curtailment of Various Office Supplies

PRODUCTION of certain office supplies—including desk pencil sharpeners and metallic file fasteners—has been ordered stopped by General Limitation Order No. L-73 as amended. Production of metal repair parts for office supplies also is prohibited, with the exception of parts for staplers and perforators (punches). Further limitations on the manufacture

of complete staplers and perforators are contained in the amended order.

✦ ✦ ✦

ONLY assembly of already fabricated metal desk pencil sharpener parts was permitted, and that stopped January 15.

✦ ✦ ✦

COMPLETE production of metallic file fasteners was ordered stopped by January 1, and manufacturers are no longer permitted to secure metal materials for their production. After December 31, only staplers using eight ounces or less of metal per unit were produced, and the same metal limit applies to two-hole perforators. Three-hole perforators may include as much as 12 ounces of metal per unit.

✦ ✦ ✦

A SAVING of about 2,300 tons of steel annually is expected to be effected through this amendment by reducing consumption of critical materials to 7,400 tons annually.

Metal Spring Prices

DOLLARS and cents maximum prices for manufacturers, wholesalers, and retailers of eight new "war model" wood-framed coil and flat bedsprings were announced December 29 by the OPA.

✦ ✦ ✦

FOUR other "war models" using heavier coil springs were given dollars and cents ceilings by OPA September 7, 1942, this ready pricing list being provided for the most commonly sold types following a change-over in manufacturing caused by a War Production Board order forbidding the use of more than 30 pounds of steel wire in any bedspring.

✦ ✦ ✦

Portable Electric Lamp and Shade Production Prohibited

PRODUCTION of portable electric lamps and shades containing critical materials was recently prohibited.

✦ ✦ ✦

THE production of wire frames for lamp shades was completely stopped January 1st, 1943.

EXCEPTED from the order (L-33 as amended) are lamps and shades produced for the Army, Navy, Maritime Commission and War Shipping Administration. However, restrictions on the use of critical materials used in production of such lamps and shades also are imposed.

✦ ✦ ✦

Further Control of Laboratory Equipment

ADDITIONAL control over the purchase of laboratory equipment was put into effect by the issuance recently of Limitation Order L-144, as amended.

✦ ✦ ✦

THE amended order provides that no purchaser of laboratory equipment shall be permitted to acquire an item valued at more than $50 or any quantity of the same item to the value of more than $50, without securing an authorization for such purchase. Application should be made on Form PD-620. Purchases author-

(*Please turn to Page 128*)

ROBINSON TUBE-TYPE **WIRE STRANDERS**

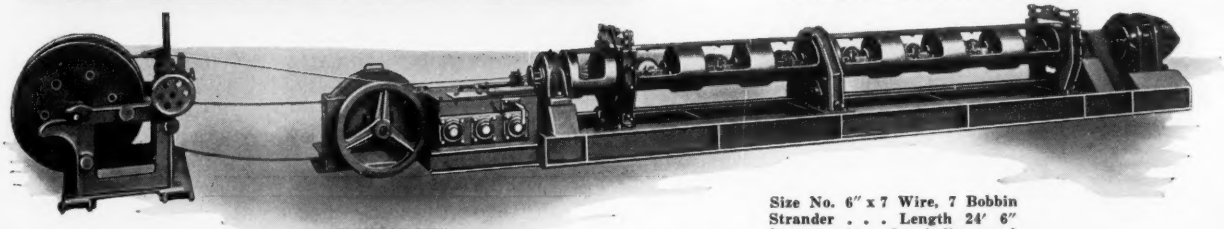
Dynamically Balanced! No Vibration!

ADJUSTABLE CRADLE MOUNTINGS

IN this new Robinson Tube-Type Wire Strander are embodied the suggestions of engineers and operators of numerous wire cable plants throughout the country. As a result of careful study and field contact, this machine now meets the most exacting requirements of the industry. Frame, main and take-off bearing mounts, gear housing and base are of all-welded construction—as structurally stable as though cast in a single unit. Steel tube of high tensile strength is statically and dynamically balanced. Gear box is designed to produce any lay within the range of lays required for its size and type. All high-speed gears are fully enclosed; they operate in a continuous oil bath. Supporting rollers of the best quality highly compressed fibrous material are mounted on spindles running in adjustable ball bearings. Bobbin latches and bobbin brakes are of new design and semi-automatic in operation.

Full information available upon inquiry. Your priority rating may permit of immediate consideration.

Write for Illustrated Manual



Size No. 6″ x 7 Wire, 7 Bobbin Strander . . . Length 24′ 6″ from center of winding reel mounting to end of strander motor. Width of strander 31″. Approximate gross weight for domestic shipment 3,000 lbs. Reel stand shipping wgt. 450 lbs.

ROBINSON MANUFACTURING COMPANY

30 CHURCH STREET, NEW YORK, N. Y.

WORKS:—MUNCY, PENNA.

UNIQUE

Government Wire Production Information

(*Continued from Page 127*)

ized on the basis of this form will be assigned an AA-4 rating.

✦ ✦ ✦

"LABORATORY equipment" is defined in the order to mean material, instruments, appliances, devices, parts thereof, tools and operating supplies for laboratories, or for use in connection with operations usually carried on in laboratories, not including second-hand items.

Brazil's Imports

BRAZILIAN trade in iron and steel products in 1941, as reported in the foreign press, shows that the United States was the leading supplier.

✦ ✦ ✦

IMPORTS of iron tubes from the United States increased from 24,771 tons (valued at $2,727,325) in 1940 to 28,116 tons ($3,822,000) in 1941; and barbed wire, from 5,394 tons ($484,971) to 9,010 tons ($938,000). Imports of wire, other than barbed, however, showed a marked decline, decreasing from 17,857 tons ($1,575,097) in 1940 to 5,349 tons ($796,000) in 1941.

✦ ✦ ✦

IN Brazil's trade with Germany, barbed-wire imports increased in value from $10,840 in 1940 to $23,230 in 1941. Decreases were reported as follows: Iron tubes and pipes, from $21,018 to $15,700; tin plates, from $4,627 to nil; iron locks and padlocks, from $4,445 to $735; iron and steel plates and sheets, from $3,059 to nil; and iron manufactures not specified from $2,840 to $12.

✦ ✦ ✦

J. D. Shaw Heads Aircraft Powder Metallurgy Activity

AIRCRAFT Parts Development Corporation, Summit, New Jersey, announces that **J. D. Shaw**, formerly research and production engineer with Metals Disintegrating Company, has joined the organization as chief powder metallurgist. In seeking wider application of metal powders in airplane production, Mr. Shaw will coordinate his activity with the corporation's mechanical division under a policy of soliciting undeveloped inventions from aeronautical engineers who are not in a position to handle their promotion.

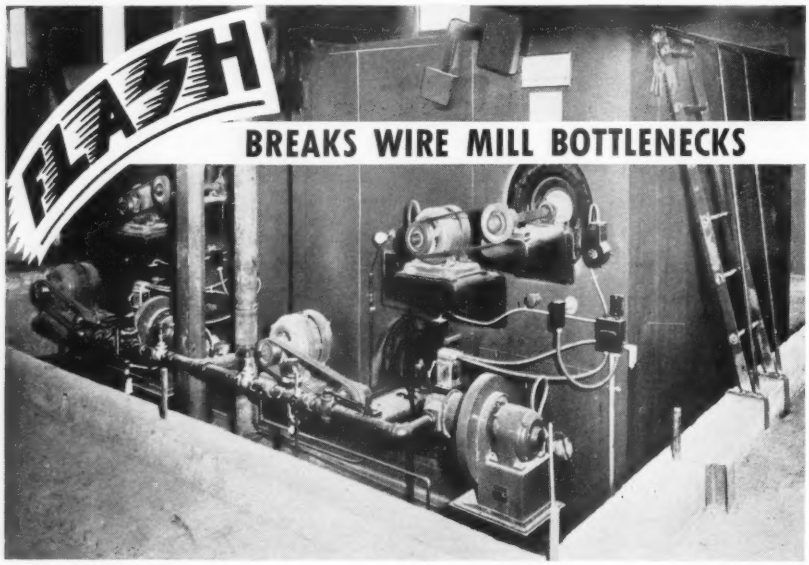
✦ ✦ ✦

R. H. Gibb, Manager of Sales, Pittsburgh District, Allegheny Ludlum Steel Corp.

FOR several years past a member of the Pittsburgh District sales organization, **Robert H. Gibb** has been appointed district manager of that office by the Allegheny Ludlum Steel Corporation, according to an announcement made by **Russell M. Allen**, the company's general sales manager.

✦ ✦ ✦

IMMEDIATELY prior to this appointment Mr. Gibb was assistant district manager of the Pittsburgh District.



Morrison Engineering in the form of the original FLASH BAKER removed a bottleneck from wire manufacturing years before the war made necessary added speed and production.

Two years ago the indirect-fired type was redesigned to incorporate last minute refinements.

Today a standardized design that shrinks hours to minutes is available for use with any type of fuel—embodying every feature dictated by a broad experience in heating and a knowledge of everything that is required to do a good baking job on any wire mill product.

Literature sent on request.

Check these Advantages of

MORRISON ENGINEERED FLASH BAKERS

SAVE SPACE
RUST-FREE ROD
VENTED HEAT
HIGH CAPACITY
HIGH RECOVERY FROM BRITTLENESS
SHORT BAKING TIME

MORRISON ENGINEERING CORPORATION
5005 EUCLID AVENUE • • CLEVELAND, OHIO
BUILDERS OF PRECISION HEAT-TREATING FURNACES AND FLASH BAKERS

When writing your suppliers, please tell them you saw their advertising in WIRE & WIRE PRODUCTS. It helps them and it helps us. Because of their advertising we are able to render a valuable editorial service to our field. It's the American Way!

Wire Association Questions & Answers

(*Continued from Page 121*)

all over the work, and this copper film kept down corrosion, between pickling and galvanizing, and was the direct cause of our obtaining a beautiful finish on our work.'

This is nothing new to me because for the past twenty years I have been suggesting that all those galvanizers using muriatic acid dip yet, place a sheet of copper in their muriatic acid dip tank, and this is for the purpose of dissolving a very small amount of copper which is thrown down over the surface of the work dipped in the muriatic acid, and this copper flashing tends to eliminate all corrosion between pickling and galvanizing, and this technique is the direct cause of the 'beautiful finish' described by this superintendent in his plant after they had pickled the copper coils in their muriatic acid dip tank used for galvanizing.

Since I have actually used this copper flashing technique for galvanizing for the past 15 years, and know that such treatment and technique does greatly improve the finish when the old muriatic acid dip method is used, and with my further investigations by actually dissolving a very small amount of copper directly in the galvanizing bath, I still believe that such small amounts as .025% of 1 per cent copper in the zinc coating is beneficial.

Copper in steel tends to deoxidize it and make it sounder steel by combining with the sulphur; a small amount of copper in zinc should also make it sounder since most zincs are smelted from "Blackjack' or 'Zinc Blende' which is the zinc sulphide. In many cases too pyrites or iron sulphides are present, and these two are sulphide ores.

Of course the final and best method of settling this question is for the A.S.T.M. to conduct some very careful investigations with—(1) an iron base and a zinc metal without any copper, and the life and service of both base metal and coating determined; (2) an iron base with copper (.023% the best amount) and a zinc coating without copper; (3) an iron base without copper and a zinc coating with copper; and (4) an iron base with .023% copper and a zinc coating on it carrying .023% copper in the zinc. Then all finish, life, corrosion resistance, service, etc., of all of these determined on sheets, poleline hardware, wire, etc., such as fence wire, and the usual articles that the A.S.T.M. uses in such tests. My suggestion does not go over .025% of copper in the zinc coating.

I will keep on the lookout for further data and information for you, so that if you get any further comments you will be able to state our case very definitely, and just what we are trying to find out. Perhaps some of your readers can give us more actual practical data and information from their own experience. Our case involves copper additions in the zinc coating not to exceed .025% of 1 per cent."

Question No. 200-42

Pickling

This question was originally presented in the October, 1942, issue of WIRE & WIRE PRODUCTS.

The following factors affect the pickling rate of steel in acid:

A. The composition of the scale covering the steel,

B. The concentration of the acid used,

C. The concentration of the dissolved salts. In the case of Sulfuric Acid the salt would be ferrous sulfate.

D. The temperature of the pickling bath.

E. Agitation,

F. The kind or composition of the steel being pickled.

The following chemical reactions take place when steel is pickled in Sulfuric Acid:

1. $FeO + H_2SO_4 = FeSo_4 + H_2O$
2. $Fe_2O_3 + H_2SO_4 = Fe_2(SO_4)_3 + 3H_2O$
3. $Fe_3O_4 + 4H_2SO_4 = FeSO_4 + Fe_2(SO_4)_3 + 4H_2O$
4. $Fe + H_2SO_4 = FeSO_4 + H_2$

Considering A through F above:

A. The composition of the scale—Three oxides must generally be considered. They range in layers from the outside surface of a piece scaled steel inwardly to the surface of the steel as follows:

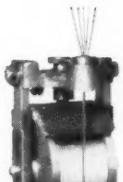
Fe_2O_3 — Fe_3O_4 — FeO — steel

The FeO is the most soluble oxide while the Fe_2O_3 is the least soluble. Actually FeO is not stable under 1045°F but decomposes into a finely divided mixture

(*Please turn to Page 130*)

"TRITON" HIGH CAPACITY WIRE CARRIERS

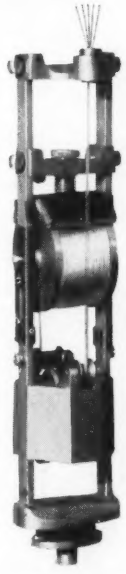
For Precision Hard Wire Braiding, Hydraulic Flexible Tubing, Hose and Electric Cables



Patented swivel top used on larger sizes.

"Triton" carriers are patented in all principal countries.

Braided flexible tubing made with "Triton" carriers.



Note the loose weights supplied in the tension box.

The latest development in wire braiding is our new carrier. Can be used on most braiding machines. New principles increase output without change in running speeds. Perfect control makes for precision braiding at all speeds. Accurately and sturdily made.

Let us quote prices. Send us your horngear size depth and profile of track and number of gears and carriers. Catalog No. 10/4 will give description and specifications of all Carter carriers. We shall be glad to send you a copy.

SOLE MANUFACTURERS

B. & F. Carter & Co., Ltd., Bolton, England

ALBION WORKS • WATERLOO STREET

MACHINERY FOR BRAIDING, TUBING, INSULATING CABLES, ETC.

Wire Association Questions and Answers

(*Continued from Page 129*)

of Fe and Fe_3O_4.

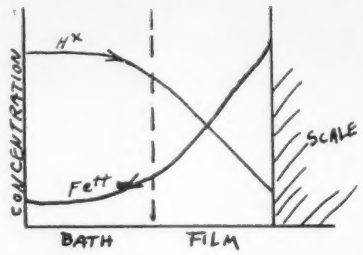
$$4FeO = Fe + Fe_3O_4$$

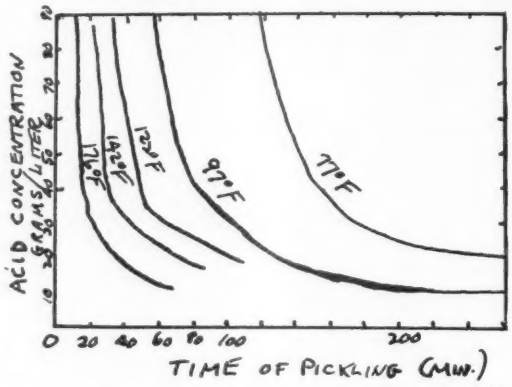
This may explain the high rate of solution of the "FeO" which dissolves out under the other two layers of oxides. It then drops off and settles to the bottom of the pickling tank dissolving very slowly and appearing as a dark reddish brown residue when the pickling tank is "dumped."

The chemical reactions which occur during the solution of the three aforementioned oxides are reactions 1, 2, 3, shown above. Reaction 4 takes place when the acid attacks the steel itself. This represents a total loss of steel as well as acid but may be largely prevented by the proper use of inhibiting agents.

The following data as given by the J. Iron Steel Inst. pt. 2 (1934), show typical scales formed on steel at three different temperatures.

B. The concentration of the acid.—The pickling rate of a sulfuric acid solution increases with an increase in concentration up to 25% acid. With further increase in concentration the pickling rate decreases. However, for ordinary pickling, the use of acid concentrations over 7-8% are not economically feasible. The efficiency of a cleaning tub is very low when the Fe content of the bath reaches 80 grams/liter. The use of higher acid concentrations would not allow the pickling bath to be worked down to a low concentration at the dumping point.





A Rod or Wire pickling tub should be dumped and made up new when the acid concentration is about 10 grams/liter and the Fe^{++} concentration about 80 grams/liter.

C. The concentration of the dissolved salts. — As the Fe^{++} (ferrous) ion concentration of a bath increases due to the building up of the $FeSO_4$ in the pickling bath (reactions 1, 3, 4), the pickling rate of the bath decreases even though the acid concentration is kept constant. This is due to an increase in viscosity of the bath. (See diagram). A stagnant film of the liquid is formed on the surface of the steel which will decrease in thickness and decreasing fluid viscosity and also with increased agitation. Hence there is better cleaning where agitation is possible. As the ferrous ions are formed they must diffuse across this stagnant film to reach the main body of the pickling bath. The ferrous ion concentration builds up at the scaled surface but drops off across

Scaling Temp. °F.	Total Scale Thickness m.m.	% of total scale FeO	Fe_3O_4	Fe_2O_3
1145	.004	23	65	12
1380	.021	82	7	11
1650	.052	79	11	10

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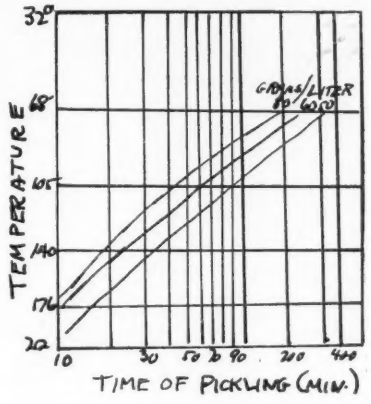
the film. As the Fe^{++} content of the bath builds up, the higher the Fe^{++} concentration at the scaled surface will have to be to maintain the diffusion rate of the ferrous ion across the film. At some point as the Fe^{++} concentration in the bath continues to build up, Fe^{++} will begin to precipitate out and the concentration differential will decrease and will continue to decrease as the Fe^{++} of the bath builds up. In practice this may be observed as the Fe^{++} concentration approaches 80 grams/liter or 8% Fe^{+++} or the ferric ion concentration does not show this effect. In fact low concentrations of Fe^{+++} actually increase the pickling rate.

D. The temperature of the pickling bath.—The pickling rate of a bath increases with an increase in temperature although this increase is not nearly as noticeable, for any one temperature, when the acid conecntration is greater than 30 grams/liter. The following curves represent the pickling times of a low carbon steel having an average scale.

In practice the average cleaning time for low carbon steels would range from 30 to 50 minutes depending on the condition of the bath. As a rule the temperature is increased from 160° F to 195° F as the iron content increases. In the case of high carbon steels a lower range of temperature is advisable in order to prevent over pickling or "burning".

E. Agitation.—A good method of agitation will reduce the time it takes to pickle because of the thinner stagnant film already mentioned in C.



F. The composition of the steel being pickled.—As a rule high carbon steels pickle much more rapidly than do low carbon steels. In actual practice this may be 2 or 3 times as fast. Bessemer and rephosphorized steels having average scales are also pickled quickly.

The following references are suggested for further information:

"Galvanizing" Bablick 1934

"Steel Wire" Bonzel (Chart on Pickling).

New Pacific Office Opened by Detroit Rex

THE Detroit Rex Products Company, metal cleaning engineers, has moved their Los Angeles office to new and larger quarters at 1506 Santa Fe Avenue. Occupying more space, the new offices will enable the company to offer the best cleaning service possible to industries in the Southern California territory.

✦ ✦ ✦

S. B. CROOKS, transferred from the Mid-Western Region with offices in Chicago, became the manager of the Pacific Region January 1st, 1943. His new headquarters will be in the Los Angeles office.

✦ ✦ ✦

W. A. VENSEL, formerly Pacific Region Manager, will supervise Sales and Service in the Southern States, effective January 1st, 1943.

COMPLETE TOWER SYSTEMS FOR INSULATED CABLE

Systems now in operation on all classes of aircraft cable, low tension communication wire and other specialty wire and cables are showing excellent results.

Advanced basic engineering design of heating, handling and lacquer pot equipment plus an overall "know how" will guarantee fine insulated finishes, high dielectric strength and high processing speeds.

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New Precision Hard Wire Braiding, for Hydraulic Flexible Tubing

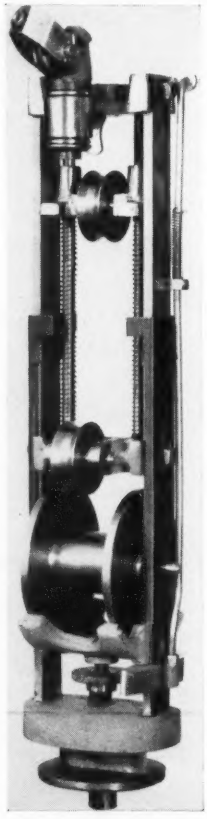
IN the past few years there has been developed a demand for a high tension wire braiding machine carrier, suitable for braiding high tensile, multiple numbers, of hard steel wire, of a tensile strength of 160 tons or more, for covering various diameters of high-pressure grease and hydraulic hose, where the minimum elongation and expansion under high pressure are important factors.

✦ ✦ ✦

B. & F. Carter & Co., Ltd., of Bolton, England, have designed and are supplying machines of special design and construction for the manufacture of these products. This latest achievement has been the production of a better machine, giving accurate and uniform tension to the wires being braided, resulting in high working pressures with uniformity of flexibility, eliminating those binding or taut points caused through the trapping of the stitches.

✦ ✦ ✦

THE carrier described is known as Type 4 AH, which is used generally on horizontal machines, either single or in tandem, and on a machine arranged with a horn-gear of 7.48″ pitch diameter. The tension is controlled by dual compression springs operating on slide rods, giving a tension of 7½ lbs.; which can be increased or decreased. The bobbin is arranged with plain flanges utilizing the full diameter of the flanges, and is controlled by friction brake release motion; instead of ratchets. By this means the wire is only paid out at even points around the race-plate, to the braiding point as it is being braided. The carrier is also illustrated above.



Improved high capacity wire carrier No. 4AH for horizontal wire precision braiding.

✦ ✦ ✦

FOR vertical braiding, they have developed a carrier, which can be used for the wire braiding of

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Representative: Architects & Builders Bldg., Indianapolis, Ind.
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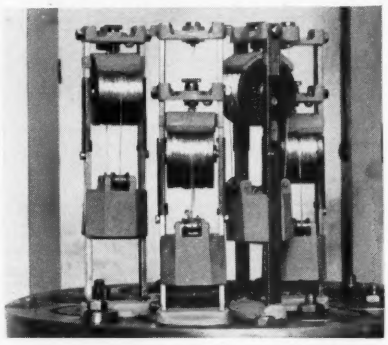
CARBIDE DIES

hose, tubes, electric cables, etc. In designing these carriers, the objectives were: 1) speed with efficiency, and 2) wire holding capacity. This has been made possible by arranging one bobbin in a high position and one in a low position therefore allowing the bobbin



The "Triton" high capacity wire carriers shown in position on the machine. ✦ ✦

size to be greatly increased in diameter, as shown in the accompanying illustration.

✦ ✦ ✦

THE list above will give the reader some indication of the size of bobbin and their capacity, against the horngear diameter, which have been increased some 200% over what had previously been attained. There is no loss of speed when these carriers are fitted; actually, an increased speed can be obtained in many instances. The tension is of gravity weight type, allowing additional weights to be loaded, as may be required, for different tensions.

Size of Carriers:-	**1A**	**3A**	**4A**	**6 lb.**
Size of Horngears:-	**4″**	**6⅜″**	**7.48″**	**11 1/16″**
Size of Bobbins:-	**2¼″ x 1¼″**	**3½″ x 1¾″**	**4½″ x 2″**	**6¼″ x 3″**
Bobbin Capacity:- (Say 29′ s.g. Copper Wire)	**1 lb.**	**3¼ lbs.**	**6 lbs.**	**17¼ lbs.**
Tension, Dead Weight:-	**1¼ lbs.**	**5¾ lbs.**	**7 lbs.**	**11 lbs.**

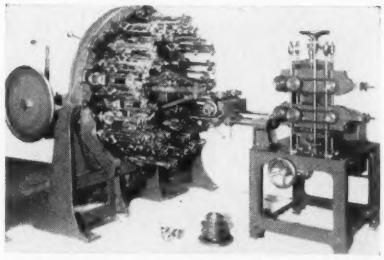
✦ ✦ ✦

THE foregoing shows that a heavier tensionsed dead weight is obtainable and also a greater length can be braided with one charge of the bobbin.

✦ ✦ ✦

ON both these carriers, the tension is so evenly applied that wire fractures are practically unknown and results would indicate that these new carriers have contributed to the advancement of the art of braiding.

✦ ✦ ✦

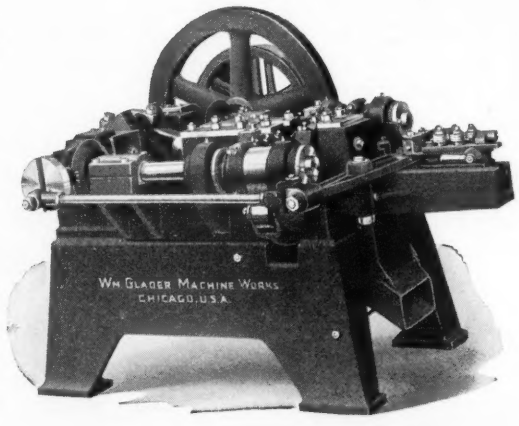


Carter's improved high speed horizontal wire braiding machine, arranged with 32-carriers, Type 4AH, with newly designed conveyor haul-off motion. ✦ ✦ ✦ ✦

THIS Company is also able to supply, in conjunction with their carriers a high speed single

(*Please turn to Page 139*)

HIGH SPEED WIRE NAIL MACHINE



WM. GLADER MACHINE WORKS

210 N. Racine Ave. Chicago, Illinois

Glader Machines on large head, single-blow roofing nails can be seen in operation at any of the independent wire mills in the United States.

The production figures on common nails shown below, are guaranteed.

SIZE MACH.	SIZE WIRE	MAX. LENGTH OF WIRE	NUMBER OF NAILS PER MIN.	CAP. IN POUNDS PER HR.
#00A	#16	1⅛″	700	37.2
#00	#14	1¼″	550	55
#0	#12	1¾″	450	89
#1	#10	2½″	400	192
#2	#8	3½″	325	310
#3	#4	5″	225	523
#4	#1	7″	190	622
#4s	5/16″	9″	175	1155
#5	⅜″	12″	160	2400

This high output and economical operation account for the GLADER machine being accepted as standard equipment in all recent installations.

A Review of Recent Wire Patents

No. 2,303,350, METAL COATING, patented December 1, 1942 by William A. Fuller, San Jose, Calif.

To produce a black coating on aluminum, this inventor provides a dilute aqueous solution of a mixture of a selenium compound, which produces selenous acid, and a soluble halogen salt of copper.

✦ ✦ ✦

No. 2,303,401, RESISTANCE OR FUSE WIRE, patented December 1, 1942 by Cecil Spencer Sivil, Roselle, N. J., assignor to Baker & Company, Inc., Newark, N. J., a corporation of New Jersey.

This wire consists of an alloy of palladium, rhodium and iridium containing palladium from sixty (60) percent to ninety five (95) per cent, and rhodium plus iridium from five (5) percent to forty (40) percent.

✦ ✦ ✦

No. 2,303,403, RESISTANCE OR FUSE WIRE, patented December 1, 1942 by Cecil Spencer Sivil, Roselle, N. J., assignor to Baker & Company, Inc., Newark, N. J., a corporation of New Jersey.

In this patent, the wire consists of the alloy of 80% to 95% palladium and 5% to 20% of metal taken from the group consisting of ruthenium and rhodium.

✦ ✦ ✦

No. 2,303,991, PRODUCTION OF STAINLESS STEEL, patented December 1, 1942 by Alexander L. Feild, Towson, Md., assignor to Rustless Iron and Steel Corporation, a corporation of Delaware.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

Steel scrap, chrome ore and iron oxide are melted down, so that the oxides of chromium and iron of the slag are reduced, the metallic values gravitating into the metal bath, and clean, sound metal of a desired high chromium content and low carbon content is achieved with a minimum carbon pick-up during the reduction of the oxides and with a substantial portion of the chromium coming from the chrome ore and yet without encountering unmanageable volumes of slag.

✦ ✦ ✦

No. 2,304,210, INSULATED ELECTRIC CABLE, patented December 8, 1942 by Thomas Robertson Scott, John Krauss Webb and John Frederick Morley, London, England, assignors to International Standard Electric Corporation, New York, N. Y.

A thin layer of conducting rubber is applied to the wire conductor, next a layer of a composite tape of conducting and nonconducting rubber, with the two conducting rubbers in contact, next a layer of insulating rubber, and thereafter a layer of the composite tape, with its nonconducting surface in contact with the insulating rubber. The whole assembly is then vulcanized.

✦ ✦ ✦

No. 2,303,651 and No. 2,304,652, SPRING STRUCTURE, patented December 8, 1942 by Anthony Pudlo, Detroit, Mich., assignor to Falls Spring and Wire Company, Detroit, Mich., a corporation of Michigan.

Seat cushion wire spring structures are provided with means to prevent sagging of the surrounding vertical upholstery material.

✦ ✦ ✦

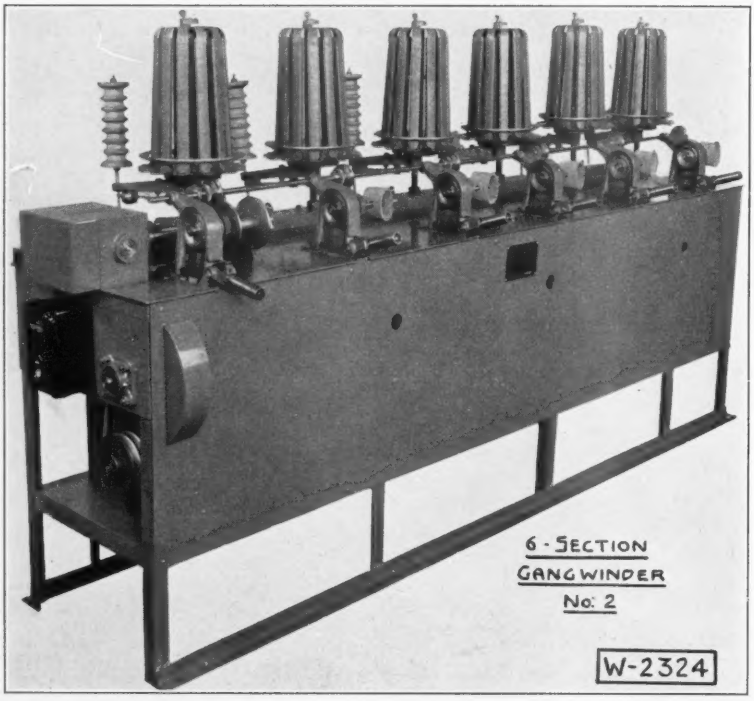
No. 2,304,990, SELF - ROLLING SCREEN, patented December 15, 1942 by Walkley B. Ewing, Grand Rapids, Mich., assignor to Ewing Development Company, Bay City, Mich., a corporation of Michigan.

Longitudinal warps and transverse wefts are provided, having at least one special warp consisting essentially of a helical filament engaged at each turn with a weft member and effective on one face plane of the fabric, and a spirally resilient filament, effective on and lying against the other face plane of the fabric within and along the helix.

✦ ✦ ✦

No. 2,305,013, SHAPED CUSHION, patented December 15, 1942 by Abraham Krakauer, Brooklyn, N. Y., assignor to Kay Manufacturing Corporation, Brooklyn, N. Y., a corporation of New York.

THE WATSON MACHINE COMPANY
PATERSON, NEW JERSEY, U.S.A.
ELECTRICAL WIRE AND CABLE AND WIRE ROPE MACHINERY



GANG WINDERS

FOR VERY FINE WIRE

INDIVIDUALLY CONTROLLED SPOOL UNITS WITH BRAKE

WITH OR WITHOUT SWIFTS

MINUTE TRAVERSE STROKE ADJUSTMENT

TABLE AND FLOOR TYPES

FOR SPOOLS TO 30" FLANGE DIA.

A wire bracing member is provided, having an S-shaped hook, engaging the outer rows of the wire coil springs and a border wire.

✦ ✦ ✦

No. 2,305,085, MACHINE FOR WINDING ELECTRICAL COILS, patented December 15, 1942 by Frederick N. Jacob and Martin J. Kirk, Chicago, Ill., assignors to Johnson Laboratories, Inc., Chicago, Ill., a corporation of Illinois.

The machine is adapted to wind inductance coils, as for radio purposes. There are 69 claims to the patent.

✦ ✦ ✦

No. 2,305,266, WIRE BENDING MACHINE, patented December 15, 1942 by John C. Lincoln, Scottsdale, Ariz., William H. Neely, Cleveland, and Svend G. Blumensaadt, Cleveland Heights, Ohio, assignors to The Universal Wire Spring Co., Cleveland, Ohio, a corporation of Ohio.

This assembly includes a number of bell cranks rotated in paralleling planes about a common axis related at right angles to the planes, and rotatable cam means driven to engage in timed relation one arm of each bell crank to effect swinging movement of its other arm toward and through a plane arranged between the first mentioned parallel planes in parallel relation with respect thereto.

✦ ✦ ✦

No. 2,305,324, WEATHERPROOF WIRE, patented December 15, 1942 by Purdum M. Snyder, Ben Avon, Pa., assignor to H. H. Robertson Company, Pittsburgh, Pa., a corporation of Pennsylvania.

Incorporated in the outer textile covering of the wire, is a metallic soap, selected from the iron-aluminum-zinc-barium group.

✦ ✦ ✦

No. 2,305,325, INSULATED WIRE, patented December 15, 1942 by Purdum M. Snyder, Ben Avon, Pa., assignor to H. H. Robertson Company, Pittsburgh, Pa., a corporation of Pennsylvania.

In this wire, a rubber covering about the wire is, in turn, covered by a textile covering, containing a metallic soap, with a bituminous finishing coating over the textile coating.

✦ ✦ ✦

No. 2,305,431, ELECTRIC CABLE, patented December 15, 1942 by Glenn Koger and James D. Lowe, Bridgeport, Conn., assignors to General Electric Company, a corporation of New York.

About the insulated central conductors, is a spiral wrapping of wire conductors and between the two the insulation comprises smooth material, providing for slippage between the conductors.

✦ ✦ ✦

No. 2,305,555, ELECTRICAL CONDUCTOR, patented December 15, 1942 by Melville F. Peters, Beltsville, Md., and Orville C. Hollepeter, Englewood, N. J.

A tungsten core for the conductor is provided for increasing the tensile strength without materially increasing magnetic effect. A copper sheath is about this core.

✦ ✦ ✦

No. 2,305,755, APPARATUS FOR CLEANING SURFACES OF BARE WIRES, patented December 22, 1942 by Takeo Akahira, Takinogawa-Ku, Tokyo, Japan; vested in the Alien Property Custodian.

The assembly includes a pair of opposed contact rollers arranged in the path of movement of the wire and mounted on respective axes parallel to the wire, cleaning bands impregnated with cleaning liquid, looped around the respective contact rollers and in contact with opposite sides of the wire, these rollers being composed of soft yieldable material whereby the cleaning bands embrace substantially the entire periphery of the wire.

✦ ✦ ✦

No. 2,305,999, METHOD AND MACHINE FOR WINDING COILS, patented December 22, 1942 by Alwin G. Steinmayer, Milwaukee, and William E. Krueger, South Milwaukee, Wis., assignors to Line Material Company, Milwaukee, Wis., a corporation of Delaware.

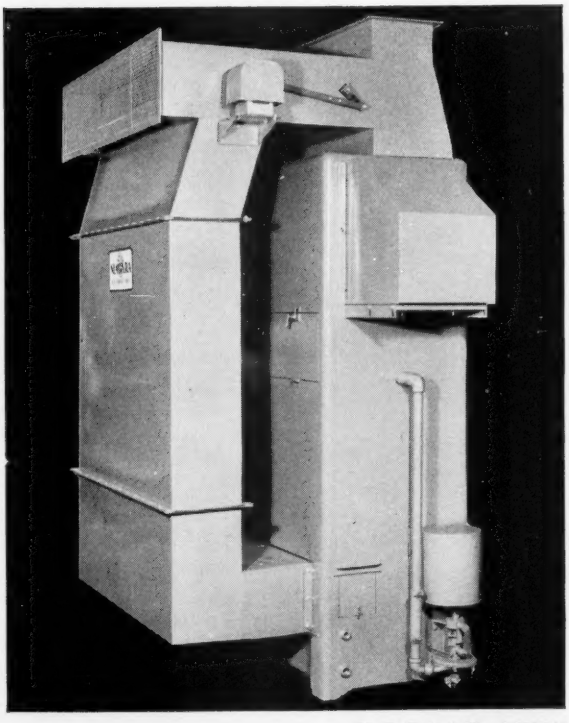
In this method of winding wire on closed magnetic cores, a multi-section cylindrical shell is placed around a part of the core with certain of the sections slightly spaced apart, winding a coil on the rotating shell by causing relative rotation of the shell and core, and reducing the diameter of the shell and removing the shell by removing successive sections thereof.

✦ ✦ ✦

No. 2,306,045, SPOOLING DEVICE FOR WIRE, patented December 22, 1942 by James K. Delano, Rye, N. Y., assignor to Delano Patents Company, Dover, Del., a corporation of Delaware.

Particularly adapted for spooling fine

(*Please turn to Page 136*)



U. S. Patent No. 2,296,946

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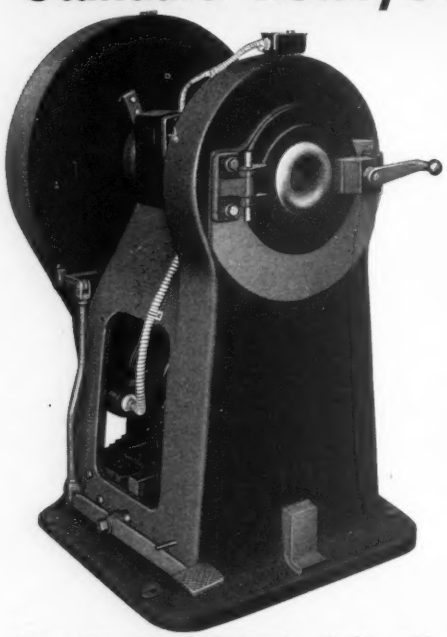

Motor driven "Standard" Swaging Machine with quick acting door clamp, safety guard around flywheel and foot brake.

- **Available in complete range of sizes for handling solid stock from ⅛" to 3¾" diameter!**
- **Used for every need from pointing wire ends to swaging connections to cable, conduit, and hose.**
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- **Engineering recommendations covering your particular job.**

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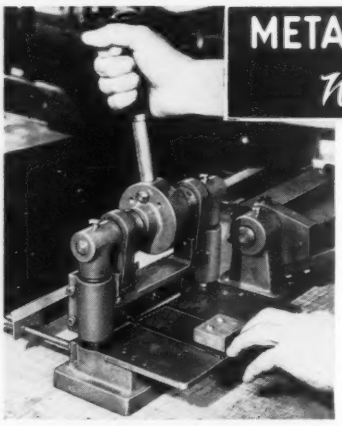
Catalog SM—A new 20-page illustrated Swaging Machine Book — Address —

Standard Machinery Co., Providence, R. I.



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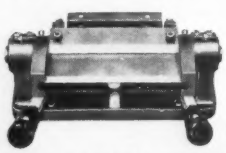
Users of Di-Acro Precision Machines—Shears, Brakes, Benders—are constantly showing US new time-saving, cost-cutting applications, in experimental work, for making small quantities of parts,—or even production runs. The Di-Acro System forms angle, channel, round or square tube, rod, moulding; round, half-round, square or flat wire, strip stock, etc.,—frequently saving Man Hours and Critical Materials. With Di-Acro Machines you can often do things impossible with dies. All work accurate to .001".

Photo (courtesy Minneapolis-Honeywell) show Di-Acro Shear No. 1, which squares up stampings, cuts strips, makes slits or notches.

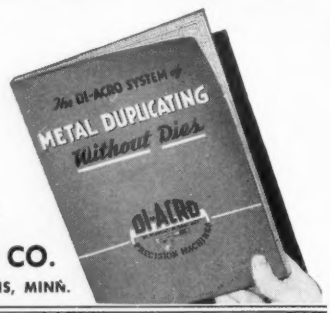
GET NEW CATALOG
"METAL DUPLICATING without DIES"

It shows Di-Acro Shears, Brakes, Benders, illustrates many parts which can be made with this creative, flexible system of DIE-LESS DUPLICATING.

BENDER



BRAKE



O'NEIL-IRWIN MANUFACTURING CO.
303 8th AVENUE SOUTH MINNEAPOLIS, MINN.

A Review of Recent Wire Patents

(Continued from Page 135)

wire, such as used in transformers, a new tensioning means is provided.

✦ ✦ ✦

No. 2,306,150, SPRING STRUCTURE, patented December 22, 1942 by Vito Asaro, Detroit, Mich., assignor to L. A. Young Spring & Wire Corporation, Detroit, Mich.

Bowed wire spring elements are provided, said to be easily assembled with the frame.

✦ ✦ ✦

No. 2,306,159, ELECTRICAL CONDUCTOR, patented December 22, 1942 by Otto A. Frederickson, Glen Ridge, N. J., assignor to National Electric Products Corporation, a corporation of Delaware.

A unitary, self-contained and non-saturant single elastic film composed of a high-polymer synthetic resin plasticized to rubber-like consistency closely surrounds a fibrous protective jacket.

✦ ✦ ✦

No. 2,306,504, WOVEN WIRE RESISTANCE, patented December 29, 1942 by Arthur H. Schafer, Flushing, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York.

Low inductance and capacitance characteristics are claimed for this woven wire structure.

✦ ✦ ✦

No. 2,306,533, ELECTRICAL CONDUCTOR, patented December 29, 1942 by Otto A. Frederickson, Glen Ridge, N. J., asignor to National Electric Products Corporation, a corporation of Delaware.

In this conductor the protective jacket is a single layer of strands of yarn, wound helically around the conductor core, with its turns closely spaced without overlap.

✦ ✦ ✦

Paul R. Fast, Plant Mgr., Rhode Island Insulated Wire Company

IT will interest our many readers and friends of Mr. Paul R. Fast to know that he is now Plant Manager for the Rhode Island Insulated Wire Company of Providence, R. I.

✦ ✦ ✦

OUR best wishes are with Mr. Fast in his new work which we are sure will do his ability full credit.

✦ ✦ ✦

New Detroit Office for Electric Furnace

THE Electric Furnace Company, Salem, Ohio, designers and builders of electric and fuel fired industrial furnaces, announce that their Detroit district representative, **B. C. Thompson,** has recently moved his sales offices from 8291 Wisner Ave., to 5911 Courville Rd., Detroit, Mich.

"Umbrella" Shields War Plants From Lightning

A WIRE "umbrella" to shield vital explosives plants and oil storage centers from lightning has been developed by **Dr. Gilbert D. McCann,** Westinghouse Electric & Manufacturing Company engineer. It is already being used by some war industries and one huge ordnance plant. Using a minimum of strategic materials, the shield easily deflects lightning driving earthward at more than 11 million miles a minute.

✦ ✦ ✦

THE shield consists simply of a steel wire strung above the building to be protected and anchored to tall wood poles at each end. The wire is then connected to steel rods buried in the ground.

✦ ✦ ✦

THIS method saves copper for other war uses. Previously explosives plants or oil depots were guarded by lightning rods which required about 250 pounds of copper attached to the building and buried in the surrounding ground. An umbrella for the same building can be erected with only 60 pounds of steel and two wood poles. With the new design danger of lightning leaping to metal sections of the building and causing sparks has been eliminated.

✦ ✦ ✦

STUDIES of lightning strokes on power lines show that each square mile of sky hurls about 10 thunderbolts at the ground each year. Modern ordnance plants have several hundred buildings spread over a large area so each plant will be a target for lightning several times a year. Just one of those strokes could cause a disastrous explosion or fire if proper protective devices were lacking.

✦ ✦ ✦

ANOTHER lightning protection plan suggested by Dr. McCann surrounds the building with six poles 10 feet higher than the roof. Steel wires extending from the top of each pole attract lightning from the area above the structure so that an invisible

(*Please turn to Page 138*)

IMMEDIATE RECOGNITION!

ACCORDED THIS FOUR-STAR BOOK

★ Practical ★ Original ★ Interesting ★ Complete

From all quarters has come commendation of this latest ASM book on practical metallurgy. Already four famous engineering schools—Case School of Applied Science . . . University of Wisconsin . . . Brooklyn Polytechnic Institute . . . Stevens Institute of Technology — are planning to use this book as a textbook for their courses in metallurgy.

Typical of other responses is that from Dr. Zay Jeffries, General Electric authority, who says: "The book constitutes a valuable addition to the literature of metallurgy".

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PRACTICAL METALLURGY

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When you change from steel dies to WILLEY'S DIES, as illustrated, production goes up—costs go down. In the vital production of small arms ammunition and cartridge cases, **Willey's Dies** are proving their worth in many war production plants.

CATALOG ON REQUEST

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Diamond and Gem Stone Industrial Production

PAUL GRODZINSKI

PRICE $5.00

The use of diamonds and gem stones as dies for fine wire drawing, and of diamonds for cutting tools, is comparatively recent. Today it is extensive and increasing. In this book the author has brought together all the data and information available on the subject and has added the results of his own experience and research. Although dealing mainly with the actual production of the dies and tools, the knowledge this book imparts is of prime importance to tool users. Efficiency and economy in the use of diamond and gem stone dies and tools is not possible without a knowledge of production methods.

✦ ✦ ✦

There are reference tables and a large number of specially drawn illustrations included in this book. An endeavor has been made to leave no phase of the subject untouched.

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THEY PATCHED IT WITH BALING WIRE . . .

. . . but you can bet your bottom dollar they wish they had had Callite Wire — drawn to the exact fine size, temper and tolerance needed to keep their plane going under any and all flying conditions.

Callite does not make baling wire . . . but if you are manufacturing a product that requires wire of exceptional quality in close tolerances and fine finish, insist on Callite Wire — noted for its consistent high quality and stamina.

Our engineers will be glad to assist you in determining the proper wire for your specific application.

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Callite Fine Wires in sizes as small as .002" can be furnished in the following metals and alloys for springs, wire forms, instrument shafts, special screw machine applications, control cables, brushes, wire cloth and other special applications.

ALUMINUM • BERYLLIUM COPPER
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PHOSPHOR BRONZE • SILVER
STAINLESS STEEL • SPECIAL ALLOYS

Callite Wires

A FINE WIRE FOR EVERY NEED

Umbrella Shields War Plants from Lightning

(*Continued from Page 137*)

lightning-proof "blanket" is suspended over the roof. Thunderbolts are drawn to the steel tips of the poles and thence to the ground.

✦ ✦ ✦

WESTINGHOUSE engineers know the character of lightning from data collected in the field by fulchronographs mounted atop fire towers, power lines and radio transmission masts. Lightning striking these structures is led to the fulchronograph which has a constantly revolving wheel. On the rim of the wheel are metal blades which are magnetized by the lightning. The number of blades magnetized and the amount of magnetism in each gives engineers a picture of the thunderbolt.

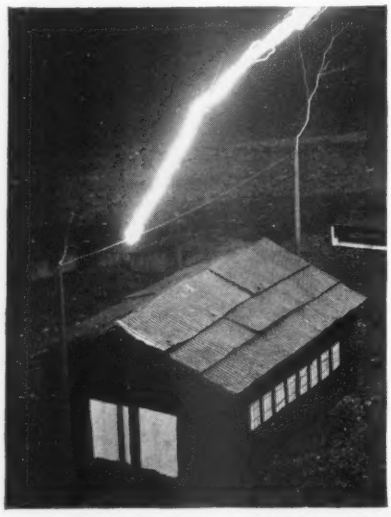

Fig. 1. "Umbrella" Wards Off Lightning—Man-made lightning streaks toward a model explosives plant but is warded off by the wire umbrella devised by Dr. Gilbert D. McCann, Westinghouse Electric & Manufacturing engineer. This picture, taken in the Westinghouse high voltage laboratory at Trafford, Pa., shows the effectiveness of the new lightning protection system which already is guarding war industries and one huge ordnance plant. A wire strung from poles at each end of the building is connected to steel rods buried in the ground, guiding lightning harmlessly into the earth. ✦ ✦ ✦ ✦

LIGHTNING strokes sometimes have a peak current of 200,000 amperes, enough to supply a city of 50,000 people with electricity momentarily. The electrical pressure in the stroke may be 20 million volts, great enough to blow out 200 million household fuses.

GIVING WIRE BLACK OR OTHER FINISHES?

Are you preparing wire and wire products for black, tinned, zinc or other finishes? If so, you know how important it is for the base metal surfaces to be CHEMICALLY CLEAN! ALL smut, oil, grease and dirt must be removed if subsequent finish is to have the requisite adhesion properties and durability.

Let effective Oakite degreasing help you do this work FASTER and EASIER. It is thorough, removes ALL foreign matter, reduces rejects. And because Oakite cleaning does this SPEEDIER, it helps keep production moving smoothly, AHEAD of schedule! Put your finishing problems up to us . . . we can help! Write today.

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Technical Service Representatives Located in All Principal Cities of the United States and Canada

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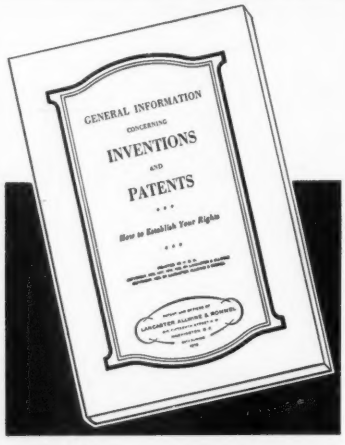

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Lancaster, Allwine & Rommel
Registered Patent & Trade-Mark Attorneys
438 Bowen Bldg., Washington, D. C.

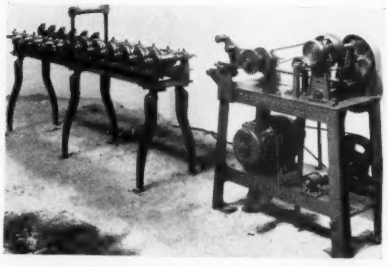
POWER line protection methods developed at Westinghouse twelve years ago by the late Dr. Charles L. G. Fortescue, noted lightning expert, guided Dr. McCann in his search for a more efficient way of shielding war plants. Dr. Fortescue improved the method of stringing a grounded wire above the lines to lead direct lightning strokes harmlessly into the earth.

✦ ✦ ✦

New Precision Hard Wire Braiding for Hydraulic Flexible Tubing

(*Continued from Page 133*)

bobbin infinitely variable traverse winding machine for handling wire from .0076" diameter. This machine, illustrated on Page 133, is suitable for winding either round or flat wires, tinned or otherwise high tensile steel wires, copper wire, brass wire, single or multiple number of ends, on to double-flanged bobbins from 1¼" to 3" between the flanges. The length of traverse can be made to suite requirements with a ratio of adjustment of half the traverse to the maximum traverse, and the pitch of lay of the wire being wound can be altered through



Infinitely variable high speed wire winding machine complete with wire creel (Motor Driven).

changewheels. A creel of special design is also recommended with this winding machine for it is essential when winding wire that an equal tension should be applied to each individual pay-out bobbin, as the wire is being paid out to keep the tension consistent.

Remember Sam in the Sunday comics? All his experiences started with: "I seen yo' ad in de paper." You see the advertising of leading concerns in WIRE & WIRE PRODUCTS. When writing them, please say you saw their ad in WIRE & WIRE PRODUCTS. Advertising service is fundamentally American.

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Wire for a thousand uses

Versatile Continental wire is produced in sizes from 34 gauge to ⅝ inch, in standard and special shapes . . . and in a wide range of analyses, tempers and coatings.

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CONTINENTAL STEEL CORPORATION ★ SUPERIOR WIRE

CONTINENTAL SUPERIOR STEEL

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SHEETS: Black, Galvanized, Copperior, Hot and Cold Rolled, Special Coated, Long Terne, etc

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FOR SWAGING, STAMPING, PIERCING, BLANKING, FORMING OF COILED METAL

WE also build machines for forming Paper Clips, Buckles, Gate Hooks, Coat and Hat Hooks, Ceiling Hooks, Wire Ears, Cable Rings, Screw Eyes, Sash Chains, Automobile Side Chains, Flat Open Link Chains, Staples, Cotter Pins, Hose Clamps, Etc., and Wire Straighteners, Wire Reels, Frame Bending Machines and Special Presses.

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for BUNCHING • BRAIDING • CABLING • COILING • CLOSING • MEASURING • STRANDING • TWISTING

A complete line of standard machines; also special machines designed or built to order. Let us know your requirements.

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European Agency: James Day (Machinery) Ltd., The Grange, Whetstone, Nr. Leicester, England.

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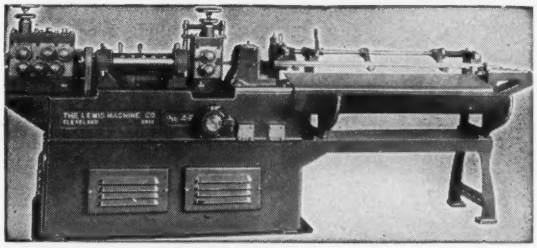

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Round
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Hexagon
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High Speed
Heavy Duty

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A Proven Product that:

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3. Inhibits rust in storage
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For High and Low Carbon Rods and Wire

Now in use in many mills
Ask us for complete information

COSTS LITTLE — SAVES MUCH

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PHILADELPHIA, PA.

Coatings for Drawing Stainless, Low & High Carbon and Copper Coated Wire

Gilron

"Gilron" Coating Compounds increase drawing speed of stainless steel wire considerably. Multiple reductions can be drawn without recoating. Excellent results on welding wire.

Better Looking Finish
No Scratching
Longer Die Life

Please write for full particulars.

Gilron Products Co.

1559 East 40th Street • Cleveland, Ohio

New Criteria for the Selection of Diamonds for Wire Drawing Dies

(*Continued from Page 114*)

0.40 carats. This is rather light for .020 bronze wire, but what of it if a few of the dies break up at that size before producing a full quota? It is the final total cost that counts.

✦ ✦ ✦

Plant Y

DRAWS hard and tough brass from .032 down to .008. At .014 the normal number of repolishings with this metal is 4 in average. The choice in this particular instance should be about 0.45 carats, which takes the stress of a .020 wire.

✦ ✦ ✦

Plant Z

DRAWS high carbon steel with highest tensile strength from .024 down to .009. We cannot figure on more than 3 repolishings on account of the quick deterioration of the diamond. The best thing to do is to select a weight sufficient for stress of a .018 wire, making extra allowance for a long bearing. Weight should be 0.50 carats for the .014 die.

✦ ✦ ✦

c) Importance of Finishing Sizes

PLANTS using many finishing sizes have an additional angle to their problem. That of finding use for the many dies purchased at finishing sizes. We take up again the example given above of Plant Z, changing their problem somewhat to the following: Draw the wire from .020 down to .014 finishing size, in three steps. Purchase of larger holes must be avoided for there will be many repolished dies available. Therefore the weight can be kept down to the .016 stress limit which should be 0.45 carats.

✦ ✦ ✦

d) Tolerance in Size and Roundness

SUPPOSING Plant Z had a very small tolerance in size and roundness for his .014 wire so that the die had to be replaced after a very small production. In that case Z will accumulate large numbers of .014 dies ready for slight repolishing and he might very well

If you MAKE or USE WIRE YOU NEED ONE OF THE MANY

Porter Cutters

Indispensable in wire mills for sampling large wire.

In almost universal use by wire fabricators for cutting reinforcing fabric, fencing, spring wire, etc.

Useful in any plant—large or small—for all sorts of maintenance and repair work—for cutting bolts, rods, wires, rivets, wire rope, chains, or for splitting deformed or "frozen" nuts.

There is a standard Porter tool for every cutting job up to ¾" annealed bolts or ½" hardened chains. Special cutters designed to fit your industry's needs.

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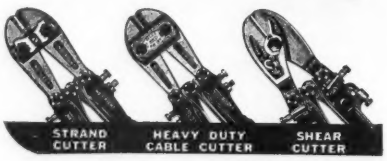

Have You a Drawing Problem?

WIRE DRAWING LUBRICANTS
for every purpose

G. WHITFIELD RICHARDS
1732-36 Carlton St.
PHILADELPHIA, PA.

take a chance on reducing the weight to 0.40 carats. Less dies will reach his top .020 size, but there will be enough for the job considering the number of .014 dies purchased.

✦ ✦ ✦

e) Method of Work, Lubrication, Speed, etc.

IF for some reason or other the exigencies of manufacturing preclude the use of the best lubricating methods, if the speed of draft is unduly high or if any other course is taken that increases the wear or the risk of breakage of the die, then too the weights should be kept down to a minimum.

✦ ✦ ✦

HERE is another example:

✦ ✦ ✦

Plant K

PRODUCES ordinary steel wire (group 3) in two sizes only: .0089 and .0099. The tolerance is wide, as much as .0002, because the wire is then rolled to be made into cheap steel wool gadgets. It does not matter if dies can be repolished and raised much higher afterwards. Plant K was interested in paying as little as possible for these dies and ordered them in 0.20 carats.

✦ ✦ ✦

f) The Kind of Care Given the Dies

THE kind of care given the dies during the drawing as well as the efficiency of the repolishing personnel must influence the weight of the stone.

✦ ✦ ✦

A FEW plants are known to have good repolishing facilities; others entrust their repolishing to the die makers. Many important firms who use but few diamond dies and cannot therefore justify the outlay for the upkeep of efficient staff and machinery, repolish their own dies notwithstanding the handicap.

✦ ✦ ✦

UNLESS perfect care can be given it is best to order dies in the cheapest weight allowed by drawing stress.

WIRE MACHINES FOR

Drawing, Enameling, Tinning, Spooling, Insulating with Glass, Asbestos, Paper Tape, Cotton, etc. Multiple Pull-outs, Rubber covered wire Panners, etc.

One of our numerous types of Multiple Pull-outs and Take-ups for use in connection with Tinning, Annealing, and Saturating Processes, etc.

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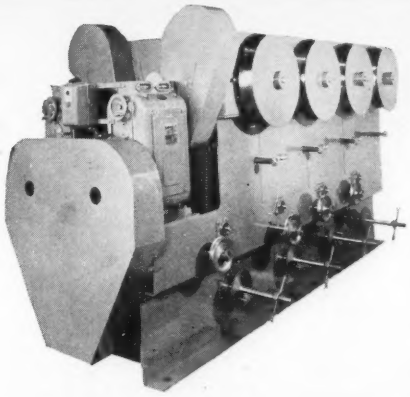

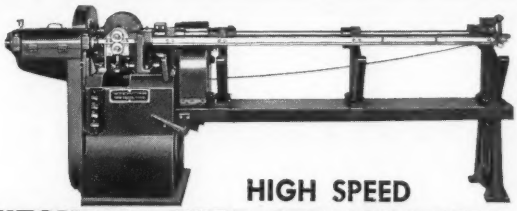

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AUTOMATIC WIRE STRAIGHTENING & CUTTING MACHINES
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For the Finest DIAMOND WIRE DRAWING DIES
Look for the mark W.W.D.CO.

What do you want in diamond dies? Diamonds of best quality; workmanship that is accurate; and dies that will give the utmost in life and the highest flawless output of wire.

Every WAYNE die will meet these requirements. Use WAYNE dies to cut your costs. Least expensive in the long run.

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Users of WAYNE dies state that "they are the best value obtainable".

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KENNETH B. LEWIS, Consulting Engineer
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495 Pages — 414 Illustrations
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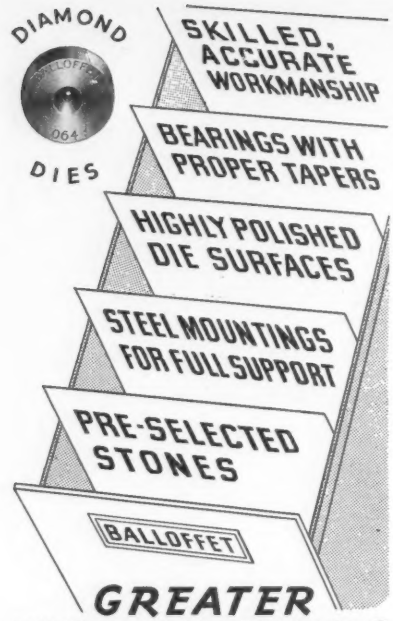

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DIES AND NOZZLE CO., Inc.
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Quality Diamond Dies Since 1879

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DIES
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Wire Drawing and Extrusion Dies made of
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Wire Drawing Diamond Dies

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Tel. Col. 5-1340

Relationship of Overtime to Cost

(*Continued from Page 115*)

ings of a department as compared with the actual overtime earnings.

✦ ✦ ✦

THE final justification will be discovered from a third statement giving the relative values of (a) the total wages actually paid and (b) the labour value of the gross output.

✦ ✦ ✦

THE difference between these figures will show whether a profit or otherwise has been made in respect of the wages and the overheads incurred.

✦ ✦ ✦

IT is in fairness to the operatives that this analysis is sectionalized for it would be inequitable and unwise to deprecate overtime valuations in respect of a complete factory or system, when dis-integration will demonstrate that only one or two departments or processes are in need of overhaul.

✦ ✦ ✦

Atlantic Wire Company Complete Annealing Expansion

(*Continued from Page 117*)

tort and that adequate pressures are being maintained underneath it.

✦ ✦ ✦

ILLUSTRATIONS show the department as viewed from both ends; also the care and detail given to the piping. One photograph shows the installation of the nitrogen gas generator.

✦ ✦ ✦

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✦ ✦ ✦

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✦ ✦ ✦

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✦ ✦ ✦

THE Hon. Sumner Whittier, Massachusetts State Senator, officiated as master of ceremonies. Governor Saltonstall, on behalf of the Commonwealth, addressed and congratulated the men and women on their high achievement in War Production. Col. W. A. Moyle of the U. S. Army presented the pennant, which was immediately raised by the Color Guard composed of Employee Members of the Massachusetts State Guard—Sgt. Russell E. Dockham, P.F.C. Frederick J. Dockham, P.F.C. Michael A. La Rocca, and Pvt. Russell E. Pilling. H. W. Porter, president of H. K. Porter, Inc., accepted the pennant. The "E" pins were presented to the employees by Capt. John J. Hyland of the U. S. Navy. Responses for the employees were made by William J. McCarthy, Jr., who with Ellen J. Sullivan and W. I. Morse represented the employees of the entire organization.

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WHERE TO BUY

For more complete information, consult the annual Wire and Wire Products Directory, Index & Buyers' Guide.

ABRASIVES—
Norton Co., Worcester, Mass.

ACID INHIBITORS—
American Chemical Paint Co., Ambler, Pa.

AIR DRAW FURNACES—
Carl-Mayer Corp., The, Cleveland, Ohio.

ALKALINE CLEANERS—
American Chemical Paint Co., Ambler, Pa.

ANNEALING POTS AND BOXES—
National Annealing Box Co., Washington, Penna.
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT—
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

BAKERS—Flash
Morrison Engr. Corp., Cleveland, Ohio.

BAKERS—Hi-Speed
Carl-Mayer Corp., The, Cleveland, Ohio.

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Morrison Engr. Corp., Cleveland, Ohio.
Moslo Machinery Co., Cleveland, Ohio.
Ross, J. O., Engineering Corp., New York, N. Y.

BENDERS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

BERYLLIUM COPPER — Strip and Bars
Callite Tungsten Corp., Union City, N. J.

BOBBINS—Braider and Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BRAKES & SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

CABLE LACQUERING OVENS
Industrial Oven Engr. Co., Cleveland, Ohio.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Carter, B. & F., & Co., Ltd., Bolton, England.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CHEMICALS—Cleaning
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

CLEANERS—Hand and Metal
American Chemical Paint Co., Ambler, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Chicago, Ill.

WHERE TO BUY, Continued

CLEANING & PICKLING EQUIPMENT—
Broden Construction Co., Cleveland, O.
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CLOTH TESTERS—
Scott, Henry L., Co., Providence, R. I.

CLOTH—Wire, All Metals
Callite Tungsten Corp., Union City, N. J.

COATING COMPOUNDS—
Gilron Products Co., Cleveland, Ohio

COILERS—Sheet, Strip and Wire
Broden Construction Co., Cleveland, O.
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.

COLD HEADERS—
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Wire Drawing
Gilron Products Co., Inc., Cleveland, Ohio.
Oakite Products, Inc., New York, N. Y.
Richards, G. Whitfield, Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

CONTROLS—Heat Treating
Niagara Blower Co., Buffalo, N. Y.

CONTROLS—Temperature
Niagara Blower Co., Buffalo, N. Y.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Vascoloy-Ramet Corp., North Chicago, Ill.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Everett, Mass.

DIAMONDS—Industrial
Callite Tungsten Corp., Union City, N. J.

DIAMOND POWDERS—
Rusch Wire Die Corp., New York, N. Y.

DIAMOND TOOLS—
Rusch Wire Die Corp., New York, N. Y.

DIE MAKING MACHINERY — For Forming Special Shapes
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Cochaud Wire Die Corp., New York, N. Y.
Fort Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Krause, F., & Co., Hillside, N. J.
Luginbill Wire Die Co., Fort Wayne, Ind.
Rusch Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Lead Extrusion
Robertson, John, Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Ajax Industrial Supplies Co., Fort Wayne, Ind.
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Firth-Sterling Steel Co., McKeesport, Pa.
Fort Wayne Wire Die, Inc., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Krause, F., & Co., Hillside, N. J.
Luginbill Wire Die Co., Fort Wayne, Ind.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Wayne Wire Die Co., Hillside, N. J.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Rod and Tube Drawing
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Tungsten Electric Corp., Union City, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tantalum Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DIES—Tungsten Carbide
Balloffet Dies & Nozzle Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., New York, N. Y.
Tungsten Electric Corp., Union City, N. J.
Vascoloy-Ramet Corp., North Chicago, Ill.
Vianney Wire Die Works, New York, N. Y.
Willey's Carbide Tool Co., Detroit, Mich.

DRAW BENCHES—
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.
Standard Machinery Co., Providence, R. I.
Vaughn Machinery Co., Cuyahoga Falls, O.

DRUMS—Flange Steel
Stevens Metal Products Co., Niles, O.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

DRYING EQUIPMENT—
Niagara Blower Co., Buffalo, N. Y.

ENGINEERS—Consulting Wire Mill
Hartley, George D., Worcester, Mass.
Lewis, Kenneth B., Worcester, Mass.

EQUIPMENT—Humidifying
Niagara Blower Co., Buffalo, N. Y.

EQUIPMENT—Industrial Cooling
Niagara Blower Co., Buffalo, N. Y.

EQUIPMENT—Insulation Testing
Davis, R. L., Electric Co., Wallingford, Conn.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

FURNACES—Annealing
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio.

FURNACES—Automatic
Carl-Mayer Corp., The, Cleveland, Ohio.
Electric Furnace Co., Salem, O.
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, O.
Firth-Sterling Steel Co., McKeesport, Pa.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, O.
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio.

FURNACES—Electric
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio

FURNACES—Hardening & Tempering
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio
Robertson, John, Co., Brooklyn, N. Y.

FURNACES—Non-Oxidizing
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio

FURNACES—Normalizing
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.

FURNACES—Salt Bath
Electric Furnace Co., Salem, Ohio
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio
Electric Furnace Co., Salem, Ohio
Rockwell, W. S., Co., New York, N. Y.
Surface Combustion, Div. of General Properties Co., Inc., Toledo, Ohio.

GALVANIZING KETTLES—
National Annealing Box Co., Washington, Penna.

GRINDERS—Roll
Norton Co., Worcester, Mass.

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Carl-Mayer Corp., The, Cleveland, Ohio

HOISTS—Electric Travelling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

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American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.

KETTLES—Galvanizing, Annealing, Tinning, etc.
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Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

LUBRICANTS—For Metal Cutting, Stamping and Drawing
Standard Industrial Compounds Co., Chicago, Ill.

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Richards, G. Whitfield, Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

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American Insulating Mach'y. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Robertson, John, Co., Brooklyn, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Braiding
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Watson Machine Co., Paterson, N. J.

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New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cable, Electric
American Insulating Mach'y. Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Closing
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Watson Machine Co., Paterson, N. J.

WHERE TO BUY, Continued

MACHINERY—Coil Winding
Robinson Mfg. Co., Muncy, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Coilers
Broden Construction Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
New England Butt Co., Providence, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc.. Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Copper Wire Drawing and Rolling
Ruesch, H. J., Machine Co.. Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Cutting
Broden Construction Co., Cleveland, Ohio
Lewis Machine Co., The, Cleveland, Ohio
Moslo Machinery, Inc., Cleveland, Ohio
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Shuster, F. B., Co., New Haven, Conn.
Sleeper & Hartley, Inc.. Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Die Making
Firth-Sterling Steel Co., McKeesport, Pa.

MACHINERY — Die Making for Forming Special Shapes
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

MACHINERY—Draw Benches
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Edging
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Enameling
American Insulating Mach'y. Co., Phila., Pa.

MACHINERY—Extruding
National Erie Corp., Erie, Pa.
Robertson, John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Flat Wire
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley. Inc.. Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Forming
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Galvanizing Wire
Broden Construction Co., Cleveland, O.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Gang Winders
Fidelity Machine Co., Philadelphia, Pa.
Robinson Mfg. Co., Muncy, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Knitting
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John, Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John, Co., Brooklyn, N. Y.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc.. Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley. Inc.. Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Material Handling
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, Ohio.

MACHINERY — Measuring Wire & Cable
Davis, R. L., Electric Co., Wallingford, Conn.
Durant Mfg. Co., Milwaukee, Wis.
Lyon-Vail Machine Co., Brockton, Mass.
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.

MACHINERY—Pointing
Broden Construction Co., Cleveland, Ohio
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Quill Winding
Fidelity Machine Co., Philadelphia, Pa.

MACHINERY—Rod Mill
Broden Construction Co., Cleveland, Ohio
Morgan Construction Co.. Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.

MACHINERY—Rolling Mill
Broden Construction Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Rubber for Insulating Wire
National Erie Corp., Erie, Pa.
Royle, John, & Sons, Paterson, N. J.

MACHINERY—Rubber Strip Covering
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
New England Butt Co., Providence, R. I.
Royle, John, & Sons, Paterson, N. J.
Sleeper & Hartley. Inc.. Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio
Emory, Robert J., Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I. (Special Designs)
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Emory, Robert J., Co., Newark, N. J.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Sleeper & Hartley. Inc.. Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
National Machinery Exchange (Used), New York, N. Y.
Sleeper & Hartley. Inc.. Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, Ohio
Lewis Machine Co., The. Cleveland. Ohio
Moslo Machinery Co., Cleveland, Ohio
National Machinery Exchange (Used), New York, N. Y.
Nilson, A. H., Machine Co., The, Bridgeport, Conn.
Ruesch, H. J., Machine Co., Newark, N. J.
Shuster, F. B., Co., New Haven, Conn.
Sleeper & Hartley. Inc.. Worcester. Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Stranding
New England Butt Co.. Providence, R. I.
Robinson Mfg. Co., Muncy, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co.. Paterson. N. J.

MACHINERY—Strip Steel
Broden Construction Co.. Cleveland. Ohio
Ruesch, H. J.. Machine Co.. Newark. N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Swaging
National Machinery Exchange (Used), New York, N. Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury. Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Testing
Robinson Mfg. Co., Muncy, Pa.
Scott, Henry L., Co., Providence, R. I.

MACHINERY—Testing Size of Wire
Davis, R. L., Electric Co., Wallingford, Conn.

MACHINERY—Testing Spring
Standard Machinery Co., Providence, R. I.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Trolley Wire
Vaughn Machinery Co.. Cuyahoga Falls, O.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Tube Mill
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Welding Wire
Micro Products Co., Chicago, Ill.
Shuster, F. B., Co., New Haven, Conn.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Fidelity Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley. Inc.. Worcester. Mass.
Torrington Mfg. Co., Torrington, Conn.
Watson Machine Co.. Paterson. N. J.

MACHINERY—Wire Bending
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

MACHINERY—Wire Drawing
American Insulating Mach'y Co., Phila., Pa.
Broden Construction Co., Cleveland, Ohio
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (Used), New York, N. Y.
Robinson Mfg. Co., Muncy, Pa.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury. Conn.

MACHINERY—Wire Measuring
Durant Mfg. Co., Milwaukee, Wis.
Lyon-Vail Machine Co., Inc., Brockton, Mass.
Watson Machine Co.. Paterson, N. J.

MACHINERY—Wire Rope
New England Butt Co., Providence. R. I.
Thomson-Judd Wire Machinery Co., Sub. of Thomson-Gibb Electric Welding Co., Lynn, Mass.
Watson Machine Co., Paterson. N. J.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence. R. I.

MACHINERY—Wood Screw
National Machinery Exchange (Used), New York, N. Y.

WHERE TO BUY, Continued

MATERIAL HANDLING EQUIPMENT
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

MILLS—Tandem Rolling and Edging
Standard Machinery Co., Providence, R. I.
Torrington Mfg. Co., Torrington, Conn.

NICKEL SILVER AND PHOSPHOR BRONZE—Rod, Wire and Strip
Hudson Wire Co., Ossining, N. Y.

OILS—Wire Drawing
Richards, G. Whitfield, Philadelphia, Pa.
Standard Industrial Compounds Co., Chicago, Ill.

OVENS—Cable Lacquering
Industrial Oven Engr. Co., Cleveland, Ohio

OVENS—Industrial
Carl-Mayer Corp., The, Cleveland, Ohio
Industrial Oven Engr. Co., Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PAINTS—Marine
American Chemical Paint Co., Ambler, Pa.

PAINTS—Structural Steel
American Chemical Paint Co., Ambler, Pa.

PANS—Lead and Spelter
National Annealing Box Co., Washington, Penna.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Crepe-Kraft Co., Newark, N. J.

PAPER TESTERS—
Scott, Henry L., Co., Providence, R. I.

PATENT ATTORNEYS—
Lancaster, Allwine and Rommel, Washington, D. C.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

PLASTIC TESTERS—
Scott, Henry L., Co., Providence, R. I.

POTS—Lead Melting
Robertson, John, Co., Brooklyn, N. Y.

POWDER—Wire Drawing
Richards, G. Whitfield, Philadelphia, Pa.

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.
Standard Machinery Co., Providence, R. I. (Mechanical Only)

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PRESSURE VESSELS—
National Annealing Box Co., Washington, Penna.

PULLERS—Wire
Scudder, E. J., Fdry. & Mach. Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

QUENCHING BATH CONTROLS—
Niagara Blower Co., Buffalo, N. Y.

REEL AND TENSION STAND—
Fidelity Machine Co., Philadelphia, Pa.
Moslo Machinery Co., Cleveland, Ohio
Robinson Mfg. Co., Muncy, Pa.
Sleeper & Hartley, Inc., Worcester, Mass.

REEL CRUTCHES—
Watson Machine Co., Paterson, N. J.

REELS—Annealing and Stranding
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS AND SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REELS—Takeoff
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Vulcanizing and Impregnating
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Shuster, F. B., Co., New Haven, Conn.
Stevens Metal Products Co., Niles, O.

REELS—Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

REFRACTORIES—High Temperature
Norton Co., Worcester, Mass.

ROD BAKERS—
Carl-Mayer Corp., The, Cleveland, Ohio
Moslo Machinery Co., Cleveland, Ohio
Ross, J. O., Engineering Corp., New York, N. Y.

RODS—Wire—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.

ROLL STRAIGHTENERS—
Moslo Machinery Co., Cleveland, Ohio

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott, Henry L., Co., Providence, R. I.

RUST PROOF COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

RUST REMOVING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.

SHEARS—
O'Neil-Irwin Mfg. Co., Minneapolis, Minn.

SHEET—Steel
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.

SOAPS—Industrial and Wire Drawing
Standard Industrial Compounds Co., Chicago, Ill.

SPOOLS—Annealing and Wire Drawing
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Shipping and Shop
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

SPOOLS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Stevens Metal Products Co., Niles, O.

STAMPINGS—Steel
Hubbard Spool Co., Chicago, Ill
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Brass and Non-Ferrous
Hudson Wire Co., Ossining, N. Y.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.

STRIP METAL TESTERS—
Scott, Henry L., Co., Providence, R. I.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TANKS—Steel
Mossberg Pressed Steel Corp., Attleboro, Mass.

TEMPERATURE CONTROLS—
Niagara Blower Co., Buffalo, N. Y.

TENSILE TESTERS—
Scott, Henry L., Co., Providence, R. I.

TESTING INSTRUMENTS—
Scott, Henry L., Co., Providence, R. I.

TOOLS—Wire Cutting
Porter, H. K., Inc., Everett, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TREADS—Safety
Norton Co., Worcester, Mass.

TRUCKS—
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS—
Ruesch, H. J., Machine Co., Newark, N. J.

TURKS HEADS—Friction and Power Driven
Standard Machinery Co., Providence, R. I.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Micro Products Co., Chicago, Ill.
Moslo Machinery Co., Cleveland, Ohio

WIRE—Cold Heading
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.

WIRE—Electric
Hudson Wire Co., Ossining, N. Y.

WIRE—Enameled for Coils
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Manufacturers
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.

WIRE—Music
Jersey Steel & Wire Corp., Irvington, N. J.

WIRE—Nickel Silver and Phosphor Bronze
Callite Tungsten Corp., Union City, N. J.
Hudson Wire Co., Ossining, N. Y.

WIRE—Non-Ferrous to Specification for Special Purposes
Callite Tungsten Corp., Union City, N. J.
Hudson Wire Co., Ossining, N. Y.
Winsted Div. of Hudson Wire Co., Winsted, Conn.

WIRE—Spring
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Firth-Sterling Steel Co., McKeesport, Pa.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.

WIRE—Stainless Steel
Callite Tungsten Corp., Union City, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corp., Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.

WIRE AND STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE TESTERS—
Scott, Henry L., Co., Providence, R. I.

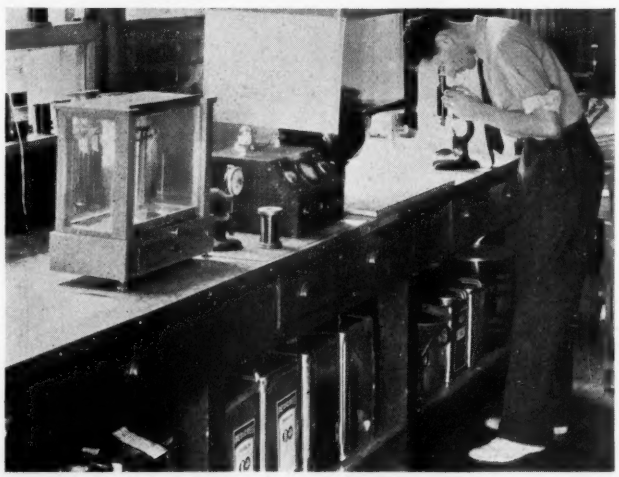
WIRE, WEAVING—Non-Ferrous
Hudson Wire Co., Ossining, N. Y.

WRAPPING PAPER—Creped
Crepe-Kraft Co., Newark, N. J.

YARN TESTERS—
Scott, Henry L., Co., Providence, R. I.

Custom built spools for high speed winding

Mercury testing for continuity of film



Checking raw materials

Don't "fool around"... USE DEPENDABLE WIRE PRODUCTS!

A product, too, is only as strong as its weakest part. Follow the practice of leading designers and engineers by specifying only service-giving wire . . . wire that has built up a reputation for "delivering the goods under fire."

Hudson Wire products, designed for discriminating manufacturers, has just such a reputation in the fine wire field. Offering greater flexibility and tensile strength, perfect laying at higher speeds, new coating methods and reduced coil dimensions without sacrificing electrical values, Hudson Wire products will probably lower your production costs considerably. Check these three points:

QUALITY— All phases of manufacture, from ingot to final processing, are carefully supervised and fulfilled in the same manner you would carry out in your own plant. There are no unimportant phases in the work.

UNIFORMITY — By mercury process tests, our engineers can guarantee perfect uniformity in wire; from the smallest to the largest order. No more variations in consistency, structure or electrical properties . . . every inch of wire exactly as specified, more than meeting your requirements.

SERVICE—If you have a wire problem, our complete design and engineering facilities are at your disposal without obligation. Send your specifications and blueprints for our recommendations; or if you are not quite ready, write for samples of these quality products.

Enameled Copper, Enameled Iron, Enameled Alloy, Enameled Aluminum, Silk Covered, Cotton Covered, Celanese Covered, Glass Fibre Covered, Twisted Multiples, Parallel Multiples and Litzendraht.

HUDSON WIRE CO.

Winsted Division

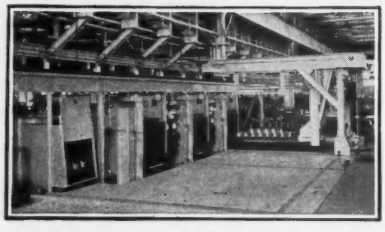
WINSTED CONNECTICUT

EF FURNACES

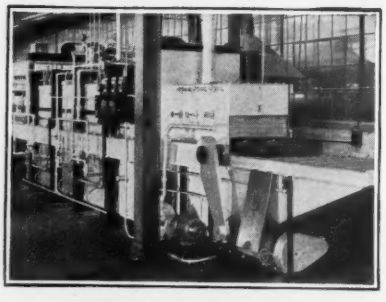
For Every Industrial Heat Treating Process

EF gas fired hearth type furnace annealing brass for cartridge cases.

EF double ended electric furnaces nitriding aircraft engine parts.



EF forced circulation furnaces, quench, cooling chamber, and material handling crane.



EF gas fired continuous roller hearth furnace annealing shell cases.

EF FURNACES ARE BUILT FOR EVERY PROCESS, INCLUDING

Annealing	Carburizing	Hardening
Copper Brazing	Drawing	Nitriding
Billet Heating	Enameling	Process Heating
Bright Annealing	Forging	Normalizing
Scale-free Hardening	Malleablizing	Ceramic Firing, etc.

EF FURNACES ARE BUILT IN VARIOUS TYPES, INCLUDING

Bell Type	Chain Belt Conveyor Type
Box Type	Chain Strand Conveyor Type
Car Type	Continucus—miscellaneous types
Hearth Type	Reciprocating Hearth
Pit Type	Rotary Hearth
Pusher Type	Rotary Drum
Recuperative	Suspended Conveyor
Roller Hearth	Vertical Cylinder
Forging Furnaces	Walking Beam

SOME ACCESSORIES WE BUILD FOR FURNACES

Conveyor Equipment	Special Atmosphere Generators
Transfer Mechanism	Pumping Equipment
Automatic Pushers	Continuous Quench Tanks
Charging Machines	Quenching Machines
Gantry Cranes	Washing Machines
Transformers	Switchboards
Pressure Systems	Contactors, etc.

THE COMPANY AND ITS SERVICE

The Electric Furnace Company, with a background of over twenty-five years of furnace building experience, is prepared to furnish any type of kiln or furnace required for any firing or heat treating process.

With both electric and fuel divisions, EF engineers are in a position to make a thorough and impartial analysis of any furnace or heat treating problem and recommend and build the best size and type furnace for the job.

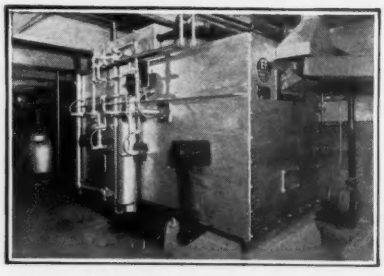
The Electric Furnace Company engineers have been able to improve heat treating processes, increase furnace production capacities or reduce the cost of heat treating operations in hundreds of prominent plants.

Consult EF Engineers on your next furnace or kiln problem. We shall be glad to give complete information, including installation and operating costs—and submit samples of products treated in equipment we have built.

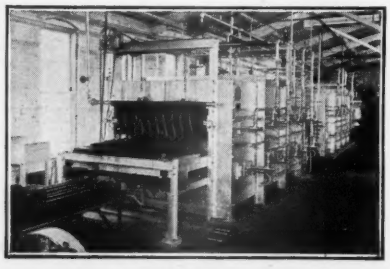
We Specialize in Building Production Furnaces.

The Electric Furnace Co., Salem, Ohio

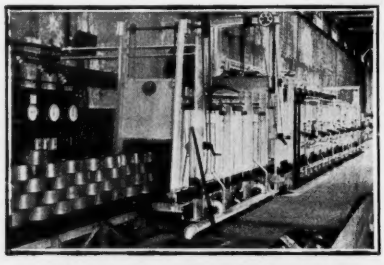
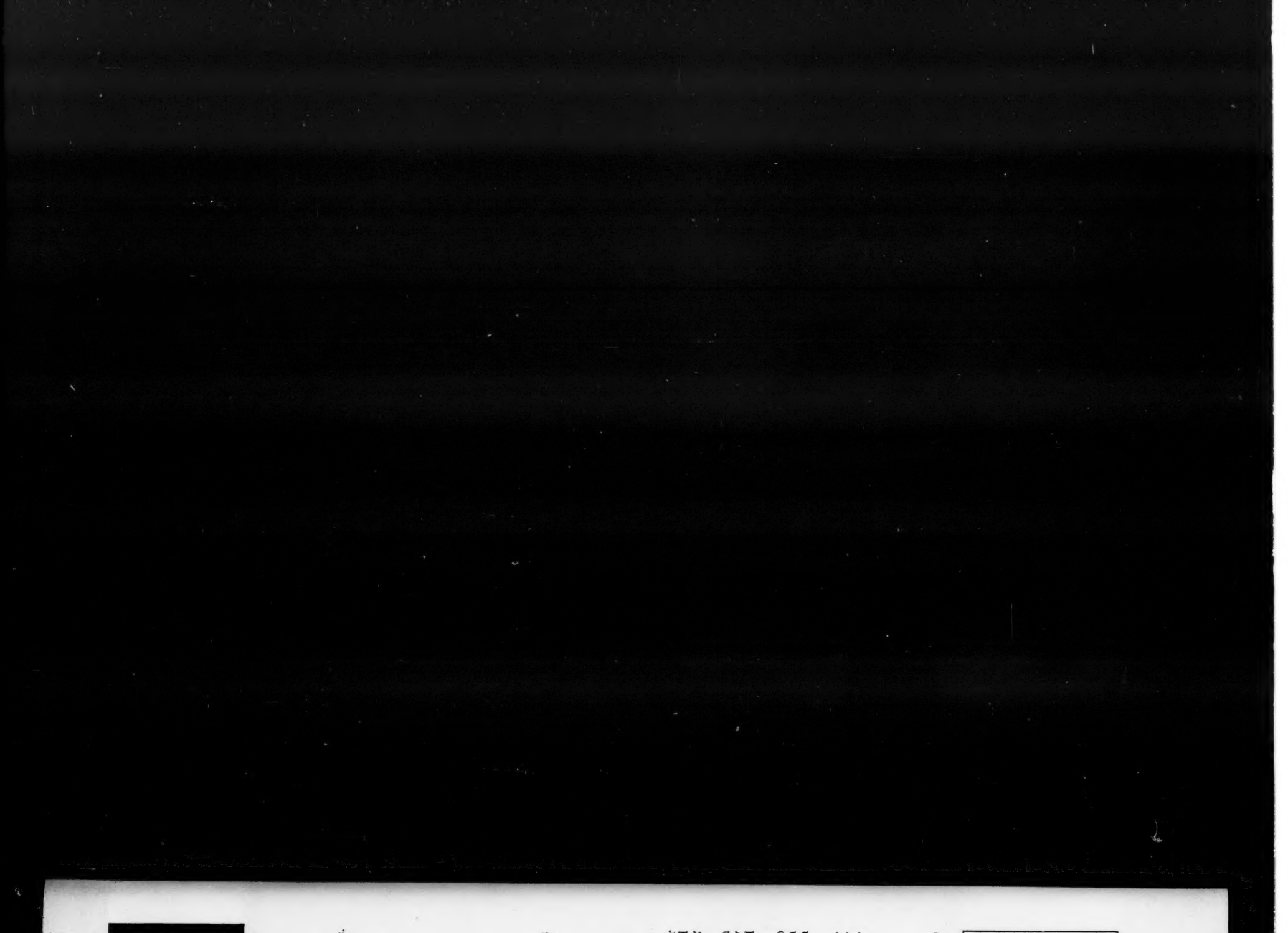
Gas Fired, Oil Fired and Electric Furnaces—For Any Process, Product or Production



EF special atmosphere furnace scale free heat treating machine gun cartridge clips—continuously.



EF gas fired special atmosphere installation heat treating shell forgings—automatically and scale free.



EF gas fired continuous roller hearth type furnace annealing 10,000 lbs. cartridge brass per hour.